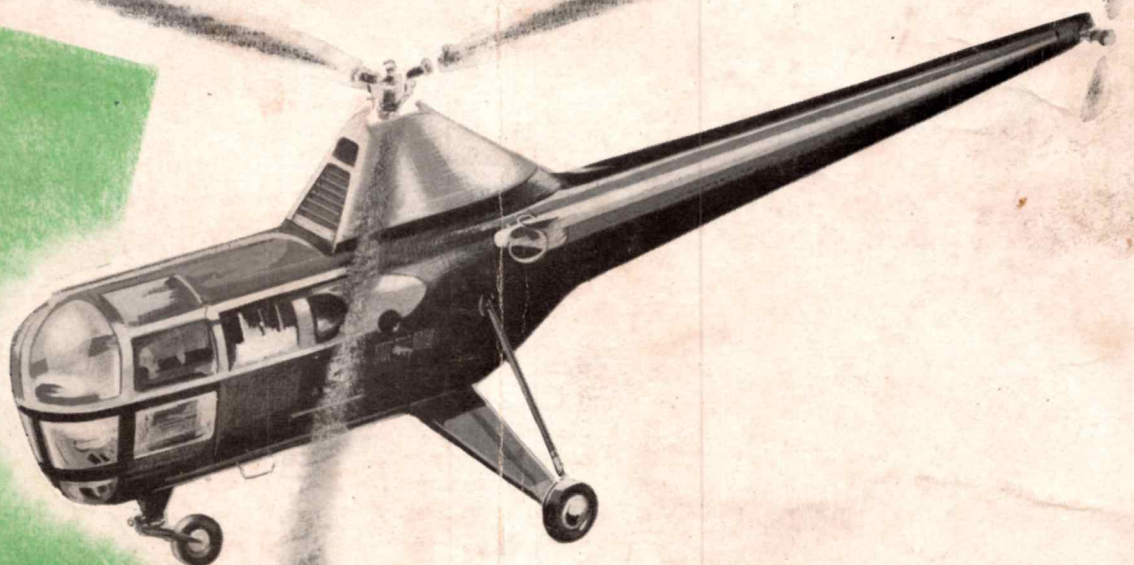


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DECEMBER, 1949 50 CENTS



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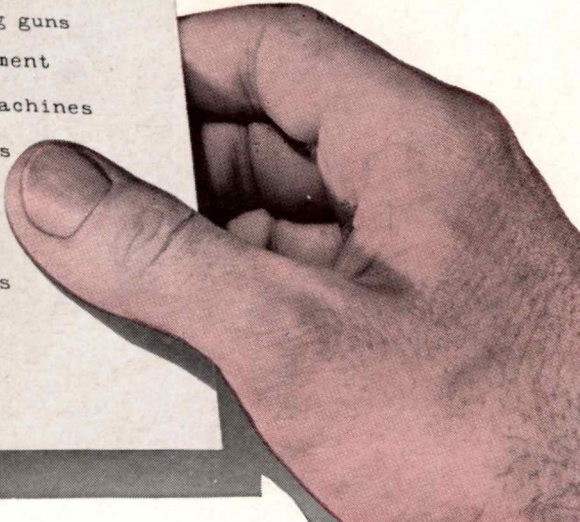
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AERO DIGEST

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AVIATION ENGINEERING

VOL. 59 ESTABLISHED 1922 No. 6

Aero Digest Weekly
LETTER TO AIRMEN
KENDALL K. HOYT, Editor

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REVISTA AEREA
Latinoamericana
MANUEL BUSTILLO, Editor

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AERO DIGEST is Indexed Regularly by Engineering Index, Inc.

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DECEMBER 1949, Volume 59 Number 6. Published monthly by The Aeronautical Digest Publishing Corporation. Publishing Office 34 North Crystal Street, East Stroudsburg, Pa. Editorial and executive offices: 615 Madison Avenue, New York 22, N. Y. (Plaza 3-6969). Cable AERODIG, New York, N. Y. Printed in U.S.A.

Single copy 50c. Subscriptions: U.S., Spain, Central and South America, \$5.00 three years, \$4.00 two years, \$3.00 one year; Canada \$6.50 three years, \$5.00 two years, \$3.50 one year. All other countries \$9.50 three years, \$7.00 two years, \$4.50 one year. When subscribing, please indicate connection with aviation industry or aviation activity.

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EDITORIAL

Let the Military Do the Fighting

UNIFICATION of the Services is well on the way to becoming effective. Industry, of course, cannot be included in the Services' unification plan. However, unification in the next war will mean the coordinated effort of the Air Force, the Army, the Navy—and Industry. It has always been an accepted fact that in time of National emergency, Industry would be ready, able and willing. Heretofore, this has always been true. Warfare in the past has been carried on with a more-or-less conventional type of weapon developed over a period of years. The development of aircraft, armament and tanks was carried on simultaneously by the world powers.

Toward the end of the last war, radical changes were taking place. No longer were we fighting with conventional weapons. The V-1, V-2, the schnorkel submarine, guided missiles, the atomic bomb, recoilless weapons, radar and supersonic aircraft were rapidly changing the techniques and strategy of warfare. They were also changing Industry into a vast research-and-development organization. Basic and scientific research by Industry and research foundations produced some startling and effective results. In most cases, the Armed Services told Industry what they wanted, and, presto—it appeared!

Industry, with its usual aggressiveness and ingenuity, came up with original ideas that added to our striking power. The incentive was there; the country was in peril; the Air Force needed this; the Navy needed that; and the Army needed something else. The boys with the slide rules went to work and invariably the Armed Forces got what they wanted. Unification was really working.

Never before had Industry played such an important part in warfare. Top brass in the Armed Services, realizing this importance, set up in all branches of the Services special departments, under various designations, but with only one objective—to insure industrial preparedness. Conferences and meetings were—and are still being—held to promote industrial planning and preparedness. However, to obtain the full use of the research-and-development facilities of Industry, the Military Services must go no further. *They must not compete with Industry.* There is a dangerous trend in that direction at the moment.

The Services have set up facilities that duplicate those of Industry—facilities that are not a military function and are a burden to both the taxpayer and the sponsoring Service. I refer to the research-and-development laboratories proposed by the Army, Navy and Air Force. A research laboratory is an extremely costly unit, both to install and operate. I wonder how much manpower and how many millions of dollars could be saved the taxpayer if these duplications of industrial activity were eliminated?

Why a Special Devices Laboratory on Long Island; another tremendous research installation at White Oaks; Naval Air Development Station at Johnsville, Pennsylvania; and now a newly proposed Radio Laboratory in the Bureau of Standards; a Guided Missile Laboratory in the same Bureau; an Air Engineering Center and Wind Tunnel for the Air Force and a Research Laboratory for the Quartermaster Corps? Industry can and would be glad to provide every research-and-development facility required by these Services. Industry can take any research-and-development project and do it better than any Government-controlled unit can do it—at a much lower cost and with a great saving in time.

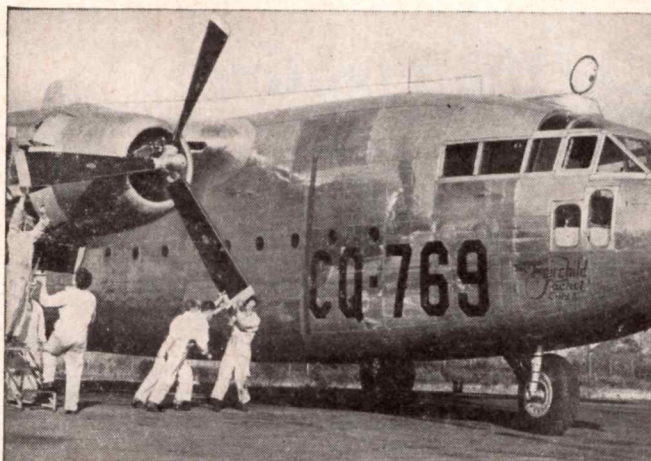
Industry is now prepared to take over all research projects; the facilities are ready and functioning. How long these industrial installations will function is dependent upon how much Government encouragement they receive. It must be remembered that the bulk of the innovations in armament and equipment did not come from Government research, design and development organizations, but from the many companies who were given the stimulating incentive of research and development.

The entire question is not wholly one of economy. It is of the utmost importance that we have available, in time of emergency, the thousands of research-and-development specialists, equipment and facilities that will be diverted into other channels unless Government cooperation is available to them.

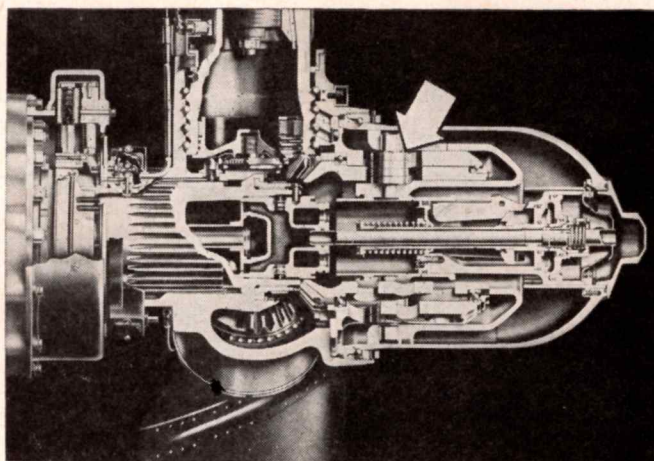
Let the Army, the Navy and the Air Force do the fighting. Let Industry provide the necessary equipment under the guidance of Military experts.

—F.A.T.

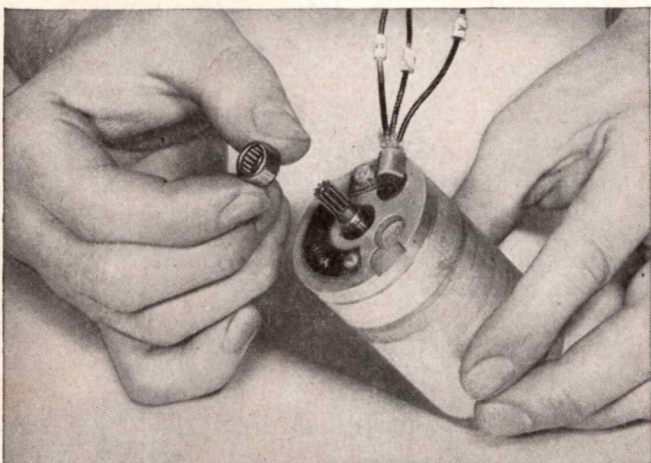
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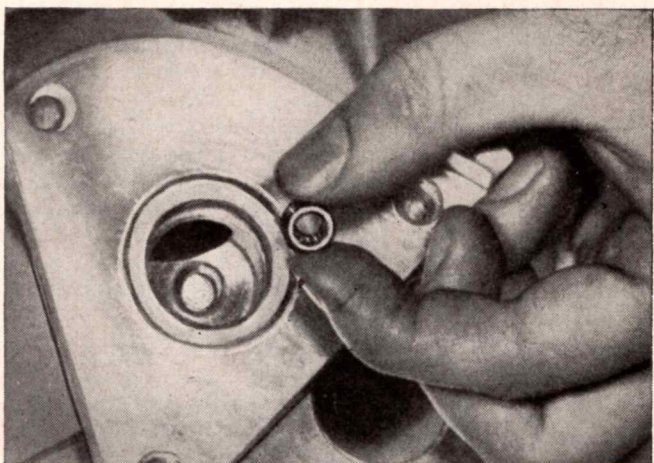
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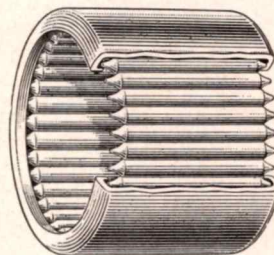


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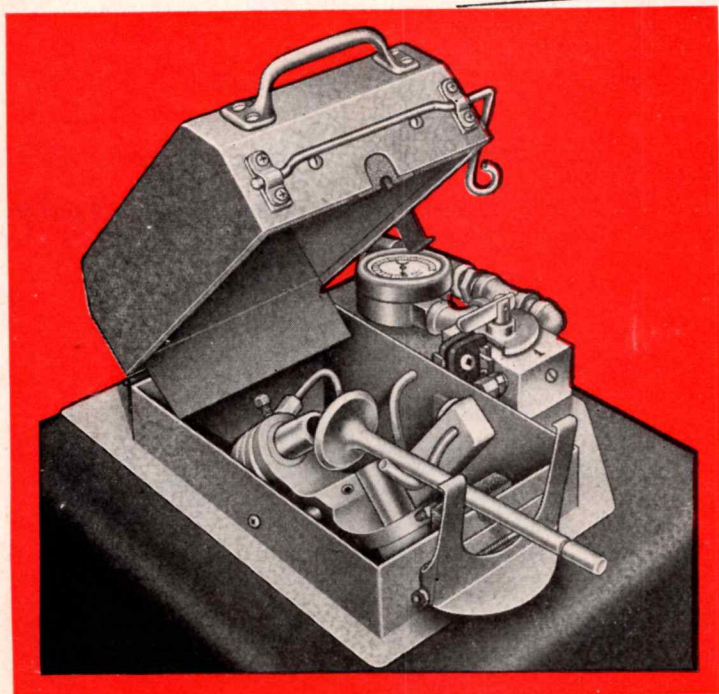
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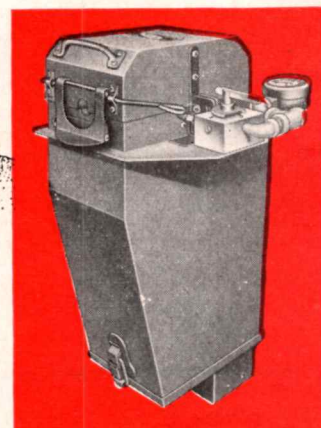
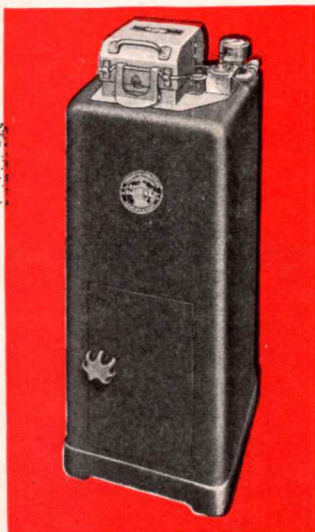
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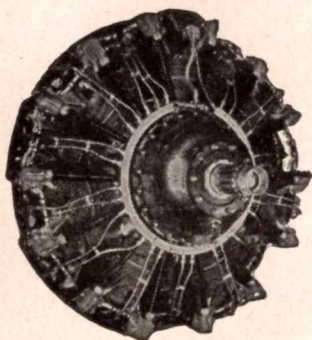
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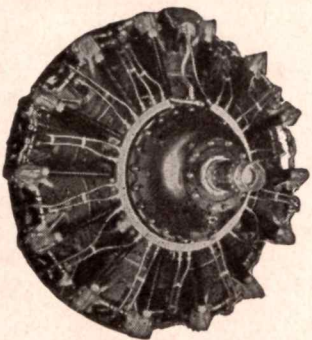
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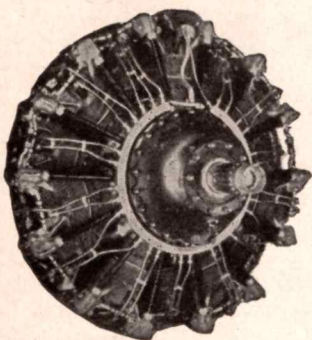
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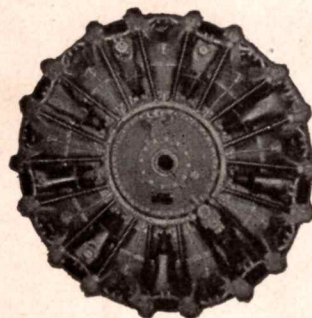


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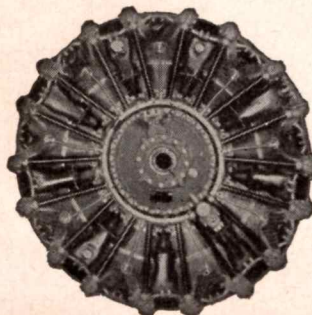
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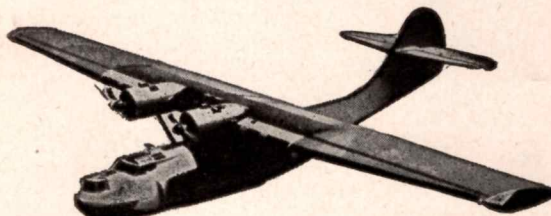
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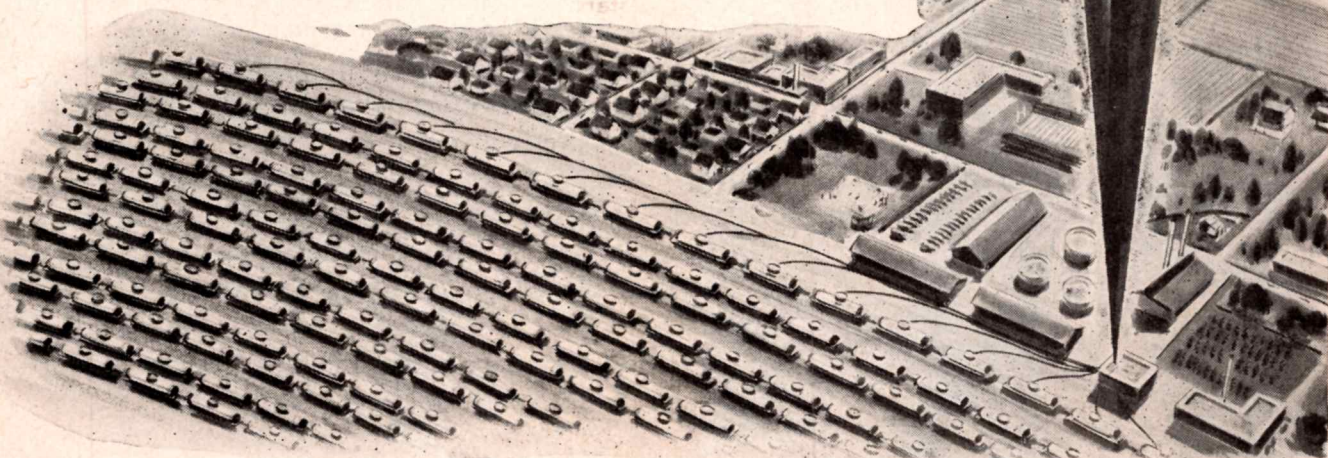
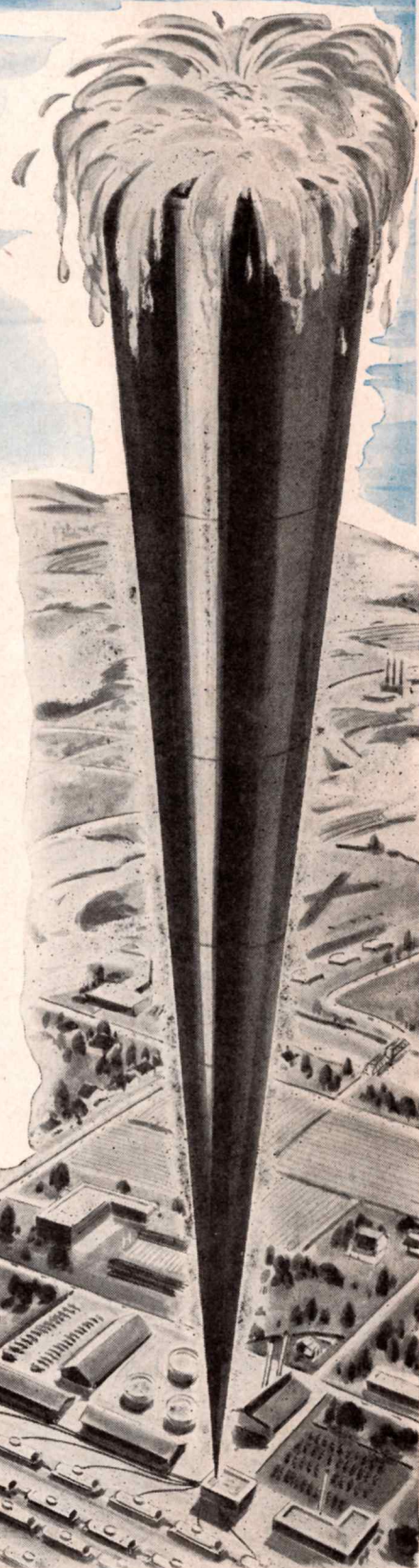
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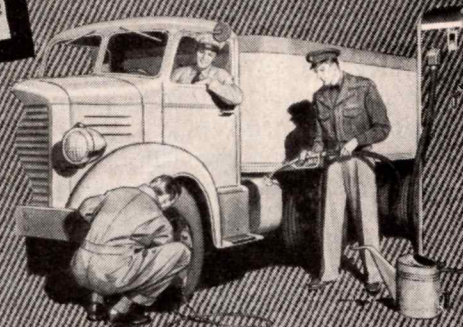
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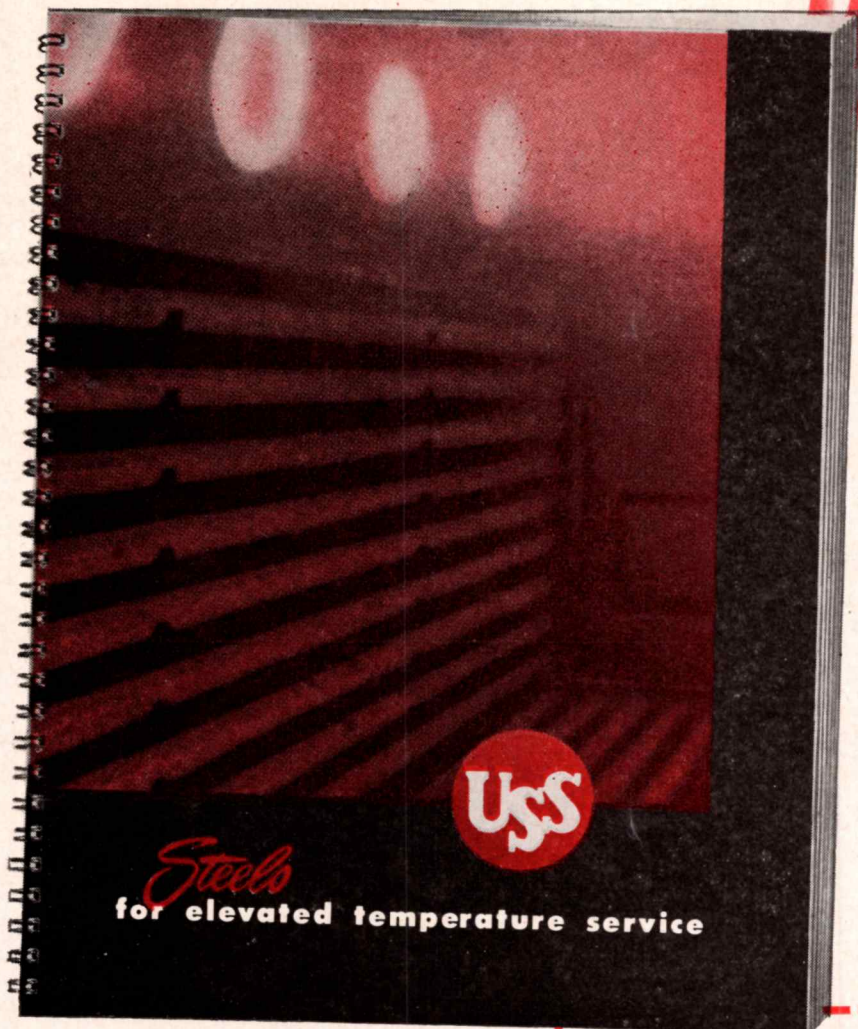
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DF18RN Magneto	Certified	60.00
SB9RN Magneto	New	60.00
SF7RN Magneto	Certified	40.00
SFI4LC7 Magneto	New	55.00
SFI4LN8 Magneto—5 hole mounting	Unused & Certified	35.00
SFI4LN8 Magneto—11 hole mounting	Unused & Certified	80.00
SFI4LU7 Magneto	New	55.00
SFI4LU7 Magneto	Repairable	25.00
SFI4RN8 Magneto	Certified	75.00

PUMPS

J50-24S-6 Deicer Pump	Repairable	5.00
Pesco-AN4101 Fuel Pump	Certified	20.00
Chandler Evans-AN4101-CE Fuel Pump	Certified	15.75
Chandler Evans-AN4101-CE Fuel Pump	Unused	20.50
Cherry Burnell-AN4101-G9 Fuel Pump	Certified	15.75
TFD100 Fuel Pump	Certified	20.00
IP582K Hydraulic Pump	Overhauled	67.50
IP349L Vacuum Pump	Certified	20.00
207JA Vacuum Pump	Certified	25.00
3P207JC Vacuum Pump	Certified	25.00
3P211JA Vacuum Pump	Certified	28.50

RADIO EQUIPMENT

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RL42B Complete Antenna Reel Assembly	New	12.75
ART-13 SH28C Auto Tune Motor	New	7.00
J1 Auto Tune Switch	New	3.00
J3 Auto Tune Switch	New	3.00
BD-8G-69 Dynamotor	New	3.00
DM32A Dynamotor	New	2.00
DM53A Dynamotor	New	3.00
PE73CM Dynamotor	Repairable	3.00
PE94A Dynamotor	New	4.00
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PE94C Dynamotor	New & Repairable	5.00
PE94D Dynamotor	New & Repairable	5.00
BC906-9 Freq. Meter	New	27.50
BC906D Freq. Meter	New	27.50
ID14-APN1 Indicator	New	4.50
MG149F Inverter	New	22.50
MG149H Inverter	New	25.00
C87 Jack Box	New	2.00
BC733D Localizer	New	14.00
MT283 ART13 Mounts	New	12.00
MT284 ART13 Mounts	New	7.00
016 ART13 Oscillator	Overhauled Serviceable	130.00
PL112 Plug	New	.75
R8U Plug	New	1.25
R1-7/APN-I Radio Altimeter	New	9.00
BC433G Receiver Radio Compass	Repairable	12.00
R5/ARN7 Radio Compass	Repairable	12.00
SCR269G Radio Compass—Complete	New	105.00
R89B Glide Path Receiver	New	26.00
TA128 Receiver Transmitter	Serviceable	12.00
BC348C Receiver	CAA Serviceable	100.00
BC348H Receiver	CAA Serviceable	100.00
BC348J Receiver	CAA Serviceable	110.00
BC348Q Receiver	CAA Serviceable	100.00
ART13 Complete Transmitter	Reconditioned	200.00

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LS514A	New	.10
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RC35S Removed from low time engines— & Reconditioned—No Electrode-wear		.45

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5358S-DC3 & C47 Shock Strut	Overhauled	175.00
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ELECTRICAL EQUIPMENT

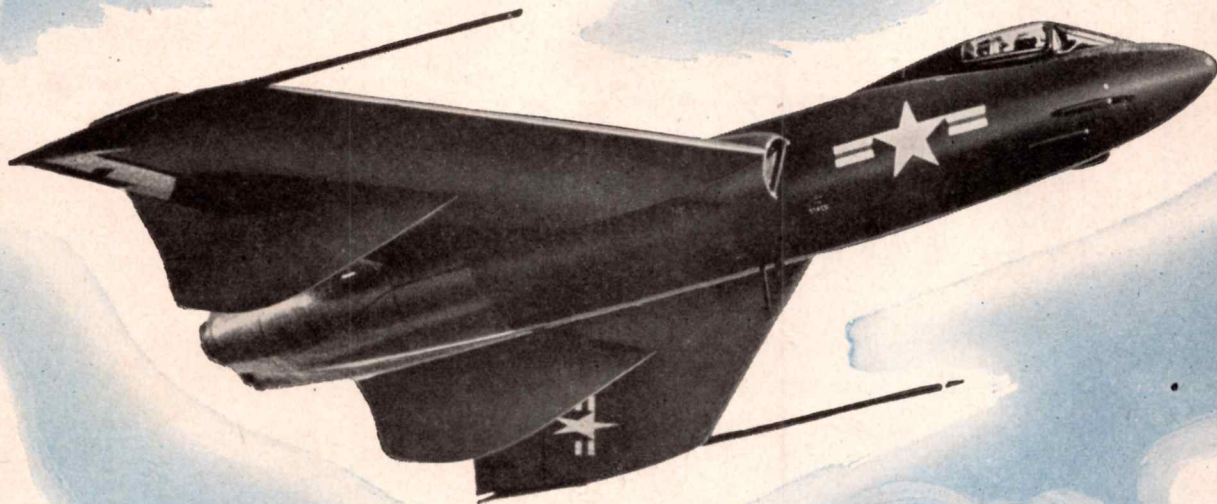
101843-04—Eclipse Armature	New	9.00
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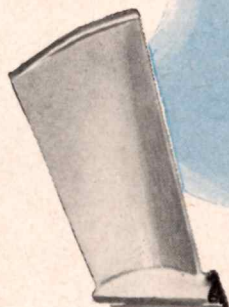
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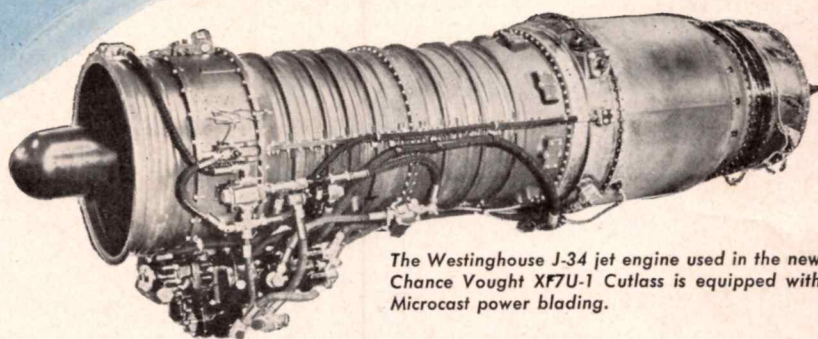


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Now the MAMBA-DC-3

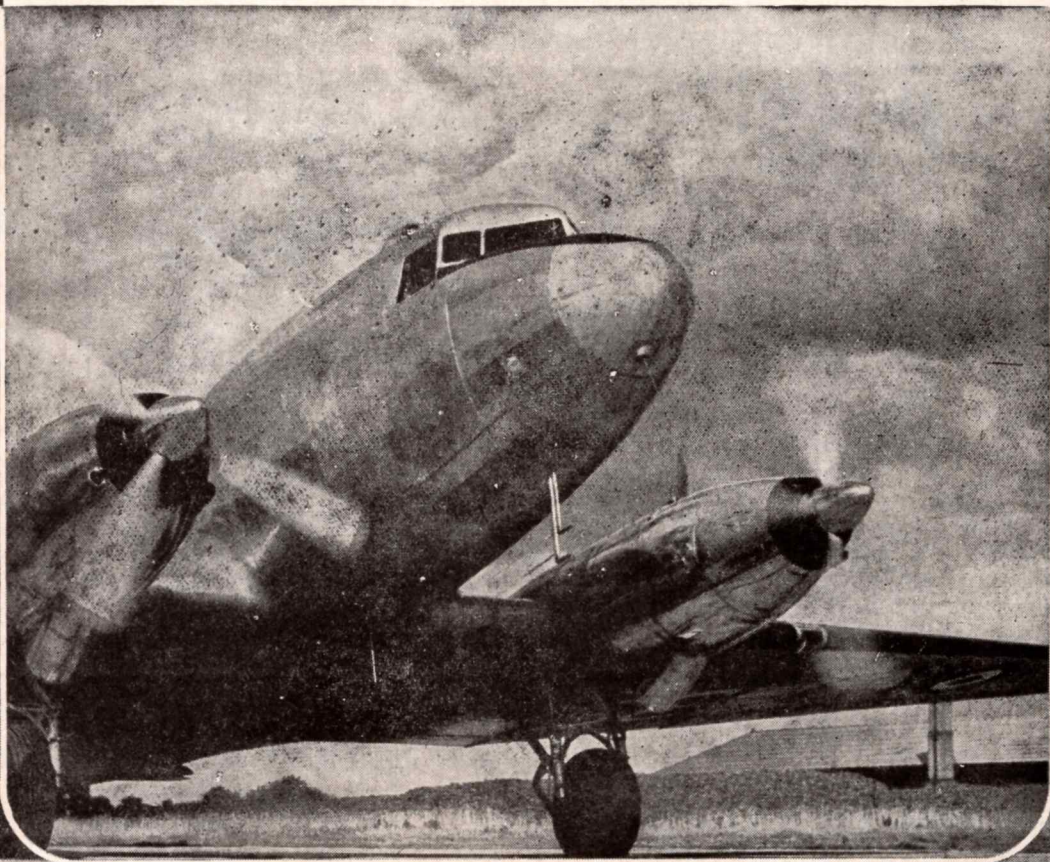
This simple conversion will enable the Douglas DC-3 Dakota to meet the full future I.C.A.O. take-off requirements at a weight only 1,300 lb. (600 Kg) less than the present maximum of 28,000 lb. (12,700 Kg). The Mamba-DC-3 Dakota offers increased speed, an improved payload on short hauls and increased comfort due to the great reduction in noise and vibration.

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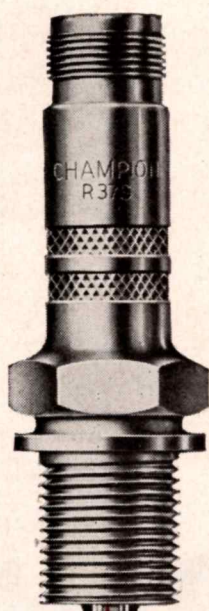
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Open Forum for Maintenance Men



R 37 S-1
Actual Size
Shielded Type

The fifth Annual Spark Plug and Ignition Clinic under the sponsorship of the Champion Spark Plug Company brought representatives of the Army, Navy, CAA and every major domestic airline as well as some overseas airlines to Toledo last September.

These men, skilled and experienced technicians, aired their views, exchanged practical ideas based on experience and otherwise brought out into the open problems affecting and affected by spark plug and ignition systems.

Champion Spark Plug engineers, working hand in hand with these maintenance men, have found this the most practical means of checking research and engineering findings with operational findings.

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Champion produces spark plugs exclusively, but recognizes that if our product is to excel, it must be considered in the light of all the things that are related to and bear upon the ultimate performance of the product in service.



C26—
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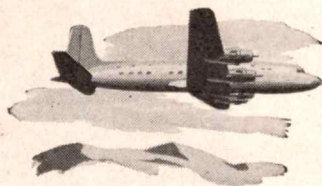
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**USE CHAMPIONS AND
FLY WITH CONFIDENCE**



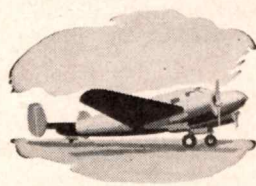
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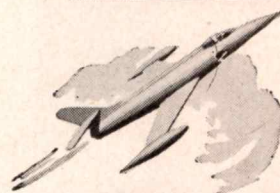
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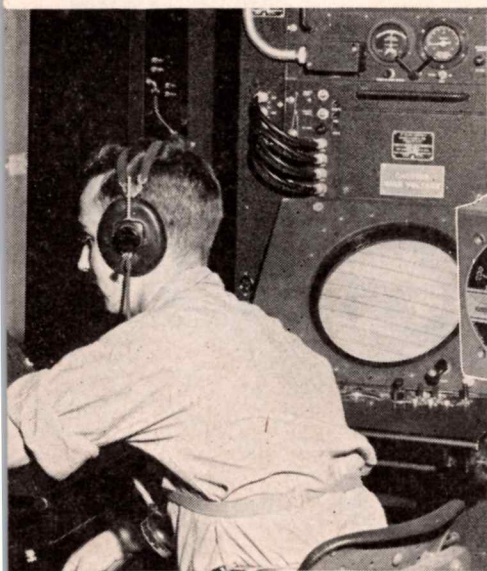
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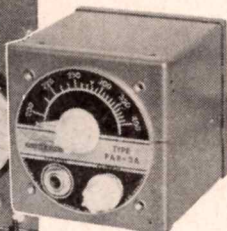


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flight instrument with a mind

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of All-Weather Flying Division, USAF and the Air Transport Association, the ZERO READER takes its place among other Sperry "firsts"—the Gyro-Horizon, Directional Gyro, Gyrosyn Compass and Gyropilot. Like these precision instruments it reflects in its performance the laboratory research and careful flight testing which have contributed to

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Continental FA-2 Airphibian takes 7 min to convert from aircraft to an automobile with 45-mph road speed

PERSONAL AIRCRAFT DEVELOPMENT

—An Official Report

A highlight during the recent annual conference of the National Association of State Aviation Officials at New Orleans was the presentation by Crocker Snow, Massachusetts Aeronautics Director, of the Research and Development Committee's 2nd Annual Report. His fellow Committee members were W. L. Anderson, Pennsylvania, Herbert Fox, Tennessee and A. W. Meadows, Texas

THE Research and Development Committee of the National Association of State Aviation Officials decided, in its first report last year, to confine itself to the general subject of personal and industrial aircraft. This was both because of the latent social importance of private air transportation (since the development of this type of aerial conveyance seemed to have lagged well behind air-carrier and military aircraft) and because there seemed to be no potent public or quasi-public agency doing much about it. Although there now appears to be an increasing awareness of the problem, the same reasons have led the Committee to follow the identical course of action this year.

In 1948, we reached the disappointing conclusion that "... little basic advance has been made in the aerodynamics of civil flying during the past year," and recommended that immediate attention be given (by indus-

try) to the development of useful small aircraft. The burden of our present report will be a current evaluation of this situation as we see it.

Also, a year ago, we noted three encouraging refinements in detail: cross-wind landing gear, external noise reduction and crash-injury research. Before proceeding further, it might be interesting to review the acceptance of these improvements.

The cross-wind gear, sponsored by the CAA, now has been approved for use on many models of production aircraft, up to and including the DC-3. Only one manufacturer, Cessna, has encouraged its extensive use, and of 17 Cessna dealers queried directly by the CAA as to customer reactions, 14 replies were favorable, two were not, and one was non-committal. Half of the favorable replies mentioned the deterring effect of the high initial cost. The anticipated corollary benefit of single-strip airports has received much

belated impetus as a result of the recent CAA policy statement limiting the expenditure of Federal airport funds to single, parallel or diverging runways.

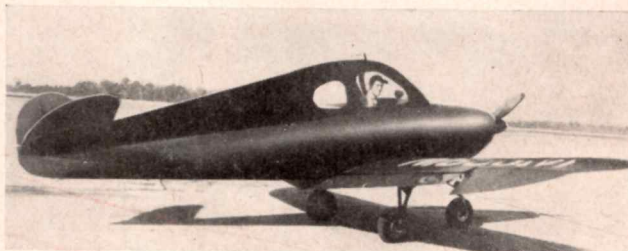
So far as we can determine, no advantage has been taken of the methods of external noise reduction perfected for the National Advisory Committee for Aeronautics by the Aeronautical Research Foundation.

The Cornell Crash Injury Research project has made continuing and intensive analyses of numerous aircraft accidents, and has been able to recommend many design changes which would increase the survival chances of occupants involved in accidents. No manufacturer as yet has incorporated all or even a majority of these features, although many are now using some of them. Hugh De Haven, project director, reports that crash-injury protection will be a basic feature of the agricultural airplane to be

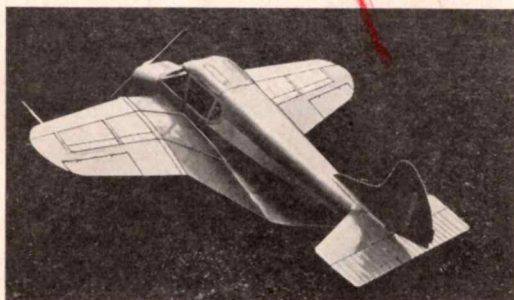
Taylor "Aerocar," now being flight-tested, due on market shortly



Koppen & Bollinger "Helioplane" operates out of tennis-court sized field



Jamieson "Jupiter," 3-place with retracting gear



Lanier "Paraplane" is said to be stall and spin proof

designed by Fred Weick at Texas A&M College for the Flying Farmers, Department of Agriculture and the CAA.

Immediately after the recent war, a national magazine conducted a survey to find out what products, unavailable during the war, were most desired, by the American public. Personal aircraft were surprisingly high on the list. The urge to be free of the hazards and inconvenience of ground transportation was widespread, and there is no reason to believe that there has been any major change in this aspiration. However, corporate records and cold statistics paint a sad picture of what has happened.

Republic Aviation and North American Aviation, both aircraft-manufacturing concerns with extensive capital resources, produced and marketed four-place personal aircraft beginning in 1946. Both, after losing large sums of money, gave up the ventures. Convair, Lockheed, Fairchild and Bendix, all companies in the same category, started to do the same thing, but quit before they reached the production stage.

In 1946, just over 33,000 personal aircraft, with a value of 92½ million dollars, were produced and sold by American firms. In 1947, the number was 16,000, worth a little over 53

million dollars. In 1948, the total had shrunk to just under 7000, valued at 28 million dollars. This year, at the current rate, production should amount to about 3700 airplanes costing \$15,800,000! This, in the face of one of the greatest business booms in U. S. history!

While there is little agreement on whom to blame, there is small doubt about what to blame. Bollinger and Tully, in the Harvard Business School study, *Personal Aircraft Business at Airports* say:

"The basic weakness of the industry was found to be attributable not so much to the obvious inadequacies of capital and management employed in sales-and-service operations, as commonly supposed, but more to inherent limitations of the product itself."

Delos Rentzel, CAA Administrator, in a statement before the Senate Committee on Interstate and Foreign Commerce comments that:

"Sales of small planes have dropped off sharply in the past two years and this potentially-important segment of our economy shows signs of stagnation. . . . to some extent, this is a matter of engineering and design changes to bring increased usefulness and lower operating costs to the small-plane owner."

William B. Stout, in a guest editorial in *AERO DIGEST* (June 1949) soliloquizes, in part:

"It is a debatable question whether the private-owner airplane industry has gone permanently into the doldrums, whether this is an Autumn or Winter of private-airplane purchasing interest, or whether the loss of interest in present-type airplane is permanent. No matter which is true, the industry can place the blame only on itself. . . . The basic fault of all private airplanes is lack of utility."

Grover Loening, speaking before the Institute of Aeronautical Sciences complained that current private aircraft "actually do not go where the individual really wants to go."

In spite of this generally accepted concept—that the present personal aircraft, though it provides a superb tool for certain specialized purposes, does not offer sufficient utility to maintain the interest of any large number of purchasers—manufacturers of those now on the market are doing little about designing or engineering any substantially improved product.

Perhaps this is understandable in view of the complaints most frequently heard; restrictive Government regulations, and the partly corollary situation, the high cost of producing prototype aircraft today. Tie these to the poor market for aviation manufacturing equities recently, and it becomes rather easy to adopt a "let George do it" attitude.

Fortunately, "George," in characteristic American fashion, is doing something about it; but we seriously question his chances for success or the chance of existing manufacturers, without assistance of the sort that our studies have led us to believe will be necessary.

Independent entrepreneurs have tackled the problem on at least four fronts: the helicopter, the slow-flying conventional airplane, the zero-speed, fixed-wing craft and the roadable airplane. All are aimed at the objective of enabling the operator to travel between more places of his own choosing

(Continued on page 72)



A Bell Model 47 helicopter used for crop dusting and spraying. Rotary-wing aircraft have been found to be very suitable for applying seed, spray or dust due to ground-air turbulence caused by rotor

California's Proposed Crop-Dusting Regulations

"AGRICULTURE is big business here. The farmer-rancher can't afford to fool around. When farm machinery stops, repairs can't wait until next week; it must be fixed and fast. When he found that an airplane could get them that badly needed part in a couple of hours instead of several days, he bought one. Now that he has one, he's discovering dozens of uses for it which save additional time and money." Speaking is Mr. Arlo Kellogg, fixed-base operator at Imperial, Nebraska, and president of the Nebraska Flying Farmers Association.

Last April, Senator Elmer Thomas of Oklahoma made a statement on the Senate floor showing the value of the airplane as a farm implement. He said:

"Down in the rich and fertile coastal plains of Texas and Louisiana, farsighted young men in both agriculture and aviation have used the airplane as an implement in planting, fertilizing and pest control of their crops. In eight flying hours, a pilot can cover over 1500 acres with a uniform application of seed, spray or dust. On the west coast, approximately 80% of the entire rice crop is planted, fertilized and weeded with the airplane. . . . It will be used extensively this year, and it is

the duty of all concerned to see that the mistakes will be lessened by the research and experimentation work which has barely started in the fields of chemistry, agriculture and aviation."

The State of California immediately took up the challenge and, in July of this year, passed legislation amending the State Agricultural Code to provide for the examination and licensing of all pilots in the business of pest con-

trol. Immediately thereafter, the California Aeronautics Commission sponsored a statewide conference on agricultural usage of aircraft. A subcommittee of this group was assigned to draft a set of suggested regulations for the operation of agricultural aircraft to be submitted to the State Department of Agriculture for its guidance in the promulgation of an agricultural aircraft and pilot code.

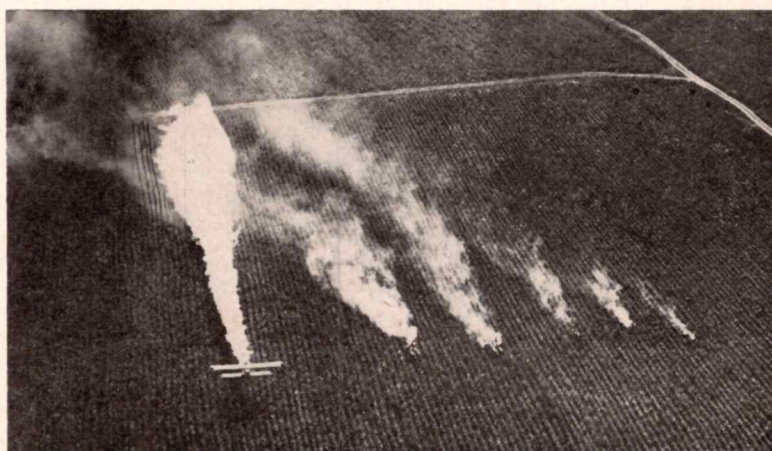
Represented on the sub-committee were the CAA, the State Aeronautics Commission, the State Agriculture Dept. and the Aerial Agricultural Operators of California. Their recommendations have been made public just recently and it is believed that they merit consideration as fine examples of progressive thinking in the fields of agriculture and industrial aviation.

The Five Sections

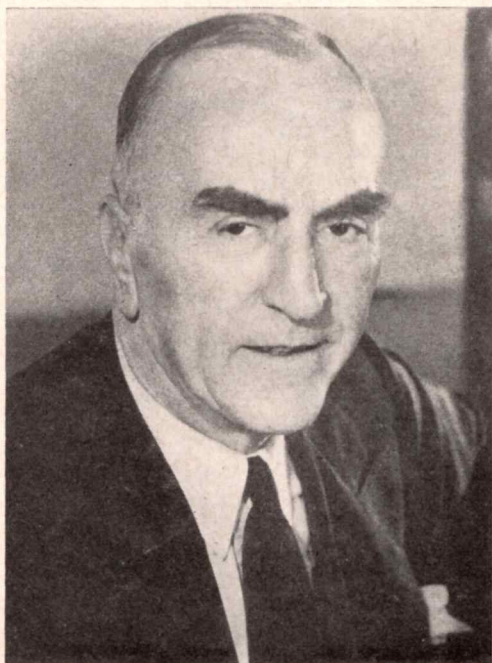
The suggested regulations are divided into five sections, the first of which contains definitions of the terms found most commonly in agricultural operations. Of interest is the definition of Agricultural Aircraft as "any aircraft applying fertilizers, seeds or any other industrial agricultural material, as well as the application of any of the substances included hereinafter under the definition of pest control." Pest Control, according to the code, shall mean "... the application of any substance, method or device to prevent, destroy, repel, mitigate or correct any disorder of plants, or to control or eradicate any pest as defined in Section 100 of the Agricultural Code." Applicator shall mean "... the pilot of any aircraft applying pest-control material or any other industrial agricultural material."

The second section concerns itself with the qualifications of persons who

(Continued on page 120)



A generation of applying techniques. Right to left: by hand, from horseback, by horse-drawn machine, by power-driven machine, by airplane



Capt. Eddie Rickenbacker

So We've Got the Jet Transport!

Before we can zip from here to Timbuctu, there are a few small problems to be solved — among them airport stacking, high-speed navigation, fuel supply and precision overhaul. "Rick's" guess is that it will take from five to seven years to make it function on anything but a "stunt" basis

CAPTAIN EDDIE RICKENBACKER

President and General Manager, Eastern Air Lines, Inc.

WHAT I know about jet propulsion is confined to a few fundamental facts. And I might say that I have never, in my association with this industry, seen a period of time when the equipment situation was so bemuddled, befuddled, confused and complicated as it is today, in so far as an airline operator is concerned.

To start with, the British, had sense enough to jump the gun and develop the jet-propelled aircraft for air transportation. There are some six-odd prototypes, as I understand it, flying in Europe today—or will be soon; one or two are propeller driven, the others are straight jet. In my opinion, the key to the momentary advantage of the British is their great knowledge, experience and progress in the development of the engine end of it. The airplane is simple, relatively insignificant.

However, we should make haste slowly, because there are millions—in fact several hundred millions—of dollars invested in present-day transport equip-

ment in this country. It can't be thrown in the ash-can. You can't give it away and you can't burn it up, because the investment is there—the stockholders' money is in it. It must be used, and used up economically, if possible.

• • •

Manufacturers can go off the deep end with a little too much enthusiasm, not enough realism or factualism, and build a jet-propelled transport plane. You can build any number of them; but whether they are the right thing or not, economically, for our industry, is another question, because there are many factors that must be analyzed, thought through and followed through in a realistic way before we jump to conclusions.

First, there is traffic control. We are a long way from having traffic control worked out in this country. How long it will take I don't know. Maybe two or

three years—maybe five—before we can really get into an airport and out on time, and without losing millions of dollars, as we are today, through the delays caused by stacking as a result of bad weather or low ceilings.

• • •

You have the navigation problem confronting you. When you get up into the five and six hundred miles-an-hour jobs, you have to think in terms of being there before you get started—almost. And I believe, when we do get traffic control thoroughly analyzed and have a practical application for controlling it, that, with jet propulsion, the day will come when a man will be assigned a positive landing time at destination before he takes off from any part of these United States.

That's how accurate it must be, because you can't afford to use jets in milling around over an airport. In the first place, you can't carry the fuel that they will burn up and be economical about it. In the second place, the speeds are too great and hazards multiply.

The other problem is loading and unloading at the ramp. There must be an entirely different procedure and technique. Maybe it is going to be a case of towing the jet transport out to the runway, or some particular spot out on the runway—or near the runway or on the taxi strip—to get it away from the ramp without burning up everybody on it and all the equipment stacked around on it.

Again, when the jets are out on the taxi strip, they must be kept moving. You can't have them lined up like we do today on a takeoff, where there are a half dozen or a dozen airplanes, one alongside of the other, because, if they turn around and push that tail into your nose, you won't have any nose—not very long.

• • •

In addition, we must think in terms of the fuel problem, the tremendous increase in fuel consumption occasioned by the jet. Today, if overnight you put jet propulsion into service, you wouldn't have one-third of the fuel capacity at the airports needed to take care of the fuel that would be used.

There is another problem: the accuracy necessary in overhauling those engines. It means a complete revision of our overhaul shops, technique and practices, because everything must be clean, temperatures kept even. Many other things are involved, details that will make it possible to do a good job quickly.

So, frankly, in my opinion, jet propulsion is not here yesterday; and yet, I have every confidence in the world that it will be here in the future. I am not worried about the jump the British have on us momentarily, because I think the burrs they put un-

About the Author

EDWARD VERNON RICKENBACKER became president and general manager of Eastern Air Lines early in 1938 and has held that post ever since. His approach to airline operations has always been a two-fisted attack on inefficiency and waste — and beating the competition to the business. He places the accent on air transportation and sees to it that his associates in the company remain ever alert to opportunities. Proof of his hard-hitting, demanding leadership is found in the fact that Eastern has been earning a profit consistently.

"Rick" studied engineering, via a correspondence course, as a boy in Ohio. This led him into the young automotive industry and into auto racing soon after. Enlisting in the World War I Army, aviation caught his fancy and he applied his energies so thoroughly that he emerged at the end of the war as America's top ace.

Returning home, automobiles again claimed his attention for a time, until he once more came into contact with the aircraft business. He has remained in the industry ever since. World War II absorbed his manifold talents in advisory and counseling capacities and also forced him to spend 23 epic days aboard a raft in the lonely Pacific.

He has managed to surmount innumerable obstacles and to turn persistent problems into assets. Those who know him surely will concede that the questions posed by the jet transport will be met just as ably.

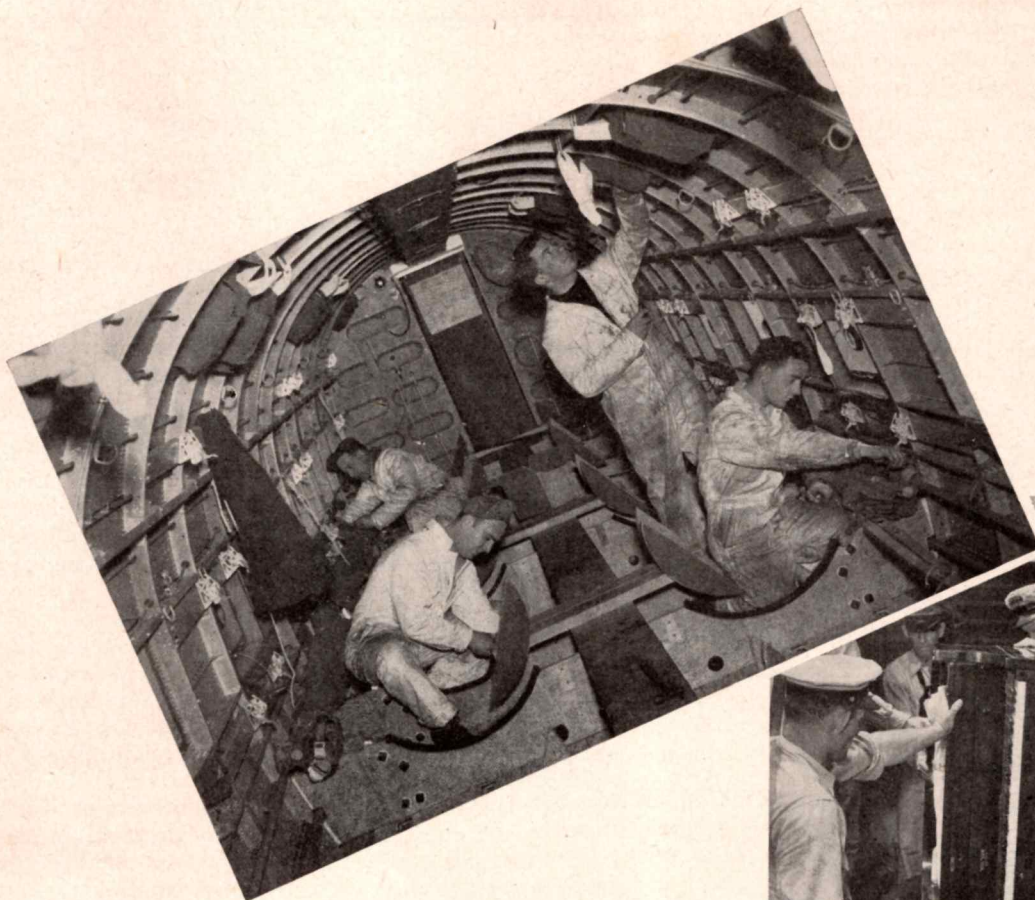
der the seat of our manufacturers have taken care of that job.

The engine end of it is involved, also, and is being taken hold of in the right manner. I don't think that you need worry about Americans buying British jets because then you really get into trouble. To start with, you have the standard system of measurements and they have the metric. Over here you couldn't handle a metric job, with the metric threads and bolts and nuts and what-not that go into a unit made over there, because you haven't got any equipment here to make them. Missing are the stocks and supplies that we have of our own standards all over this country in every two-by-four shop.

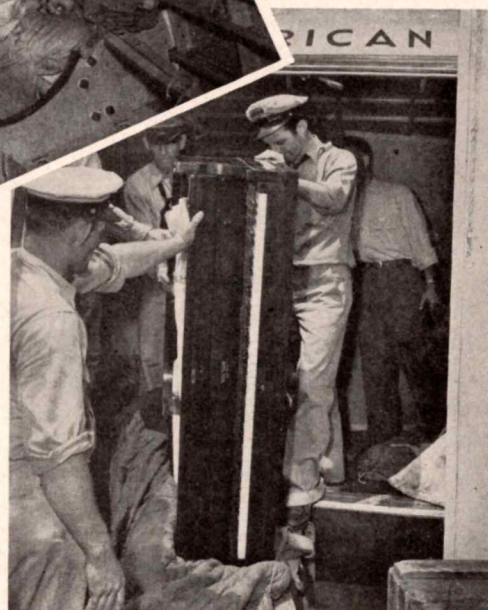
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Furthermore, think of the service problem, the parts involved. Sure, you may be able to go over there in five hours. But to go over there to get parts and come back here is another story by comparison with trying to get them here within our own boundaries. They don't operate as we do; their philosophies are not the same. Let's be realistic and practical about it.

So, even if they do build jet jobs, like the *Comet* or like the Vickers *Viking* turboprop—to start with,
(Continued on page 110)



Mechanics converting a war surplus Douglas C-47 into a plush, combination passenger-and-cargo transport. Fuselage and bulkheads will be insulated and covered; new reinforced flooring with provisions for removable chair-type seats must be laid. Modification necessitates a large capital outlay on the part of the operator and should be considered in initial design



A commercial shipment of household furniture being loaded in a Convair Model 39. Blanket only partially protects door sills

COST FACTORS IN TRANSPORT MAINTENANCE

WILLIS L. NYE

Supt. Production Control, Aircraft Engineering & Maintenance Co.

THE operational cost of an air transport consists of fixed overhead costs, flight cost and maintenance cost to keep the airplane in an airworthy condition. The development of close competition between nationally expanded air-cargo lines and surface competition makes it mandatory that the trend of maintenance costs shall be downward, if profitable flight operations are to be conducted.

Naturally, experienced maintenance organizations have devised ingenious man-hour reductions to keep maintenance costs at a minimum. But a major problem to be solved in main-

tenance is the tendency of the airframe manufacturer to build cargo planes along the same conventional lines as those of passenger transports. What the airframe manufacturer must recognize is that low maintenance cost is a matter of functional design. And functional design must be backed by an overhaul and spare-parts policy which makes it possible to obtain replacement spares quickly at quantity cost.

Airframe manufacturers prepare elaborate sales brochures which emphasize low cost/ton-mile flight operation. They treat maintenance in a cavalier fashion by elaboration of how

quickly an engine change may be made (usually under ideal conditions); but they fail to state anything as to the cost and availability of overhaul spares or other pertinent factors of maintenance costs. For example, it should be possible to develop a spare-parts manufacturing program based on the life of type. By this is meant that if the airplane is theoretically designed to be usable for a minimum of 16,000 hours of operation, then sufficient overhaul spares should be manufactured to provide available parts for that longevity of operation or whatever it may be. As it is at the present

time, only a minimum of overhaul spares is maintained in stock and, if it is depleted, the operator may have to wait 30, 60, or 90 days for new parts.

So the alternatives of having overhaul spares fabricated locally (usually at exorbitant prices), are to buy old or used parts and rework them—or buy surplus parts, if these be available. The airframe manufacturer, once his overhaul spare stock is depleted, cannot manufacture a few parts as per order, but must wait until sufficient orders accrue to make it profitable to fabricate the minimum quantity of parts to the catalogued price. Therefore, while the manufacturer's initial investment to manufacture sufficient anticipated overhaul spares for the "life-of-type" is a costly outlay, it seems logical to assume it as an aggregate cost that must be made in order to permit the owners of transports to keep their planes operating with the minimum of lost time. The entire parts sale would then be to his advantage.

Cleaning.—Post-war cargo transports carry every kind of material and commodity common to surface carriers. Therefore, the basic design of an air transport should be such that, at the time of the periodic check or at engine change, it should be possible to clean the airframe thoroughly with a minimum of manpower expenditure. Steam cleaning and vapor-degreasing materials do an excellent job, but the major difficulty is the time involved to clean inaccessible parts of the airframe.

For example, the contents of sack cargo tend to penetrate all cracks of the cargo decking and sift to the lower interior of the airframe where removal

is laborious. It seems reasonable to assume that some method of sealing the cargo floor decking at the joints and sides is in order. Inspection-access plates on the bottom of the fuselage would be helpful.

Similarly, certain of the functional, system lines should be provided with low points, or traps, so that, with drains provided, cleaning solvents may flow through them and then be removed by air pressure or by gravity flow. Cleaning of supply lines is arduous and it is also a safety item. Positive methods must be devised so that all waste lines which drain overboard, deposit the contents clear of the outer skin to prevent skin deterioration. Corrosion-resistant steel panels in the area adjacent to heater exhaust areas are helpful.

Lubrication Fittings.—Lubrication fittings of various functional components should be accessible conveniently so that special lubrication accessories are not necessary. In some instances, accessibility has been entirely disregarded in the initial design.

Interchangeability of Cowling and Nacelle Panels.—Although it is assumed that all aircraft parts are tooled accurately, it still is necessary to place identifying marks on segments of engine cowls and nacelle panels to obtain proper fit. As a result of the lack of fit, engine cowling must be fitted at engine build-up and then removed prior to engine installation to provide access to the engine. After the engine has been placed, the cowling is then reinstalled prior to engine run-up. Much of the distortion of engine cowls is attributable also to wear in handling, but since cowl parts are subjected to air loads, bursting loads,

vibration and handling, sturdier construction is required, even at the expense of weight increase. The same is attributable to engine cowl flaps:

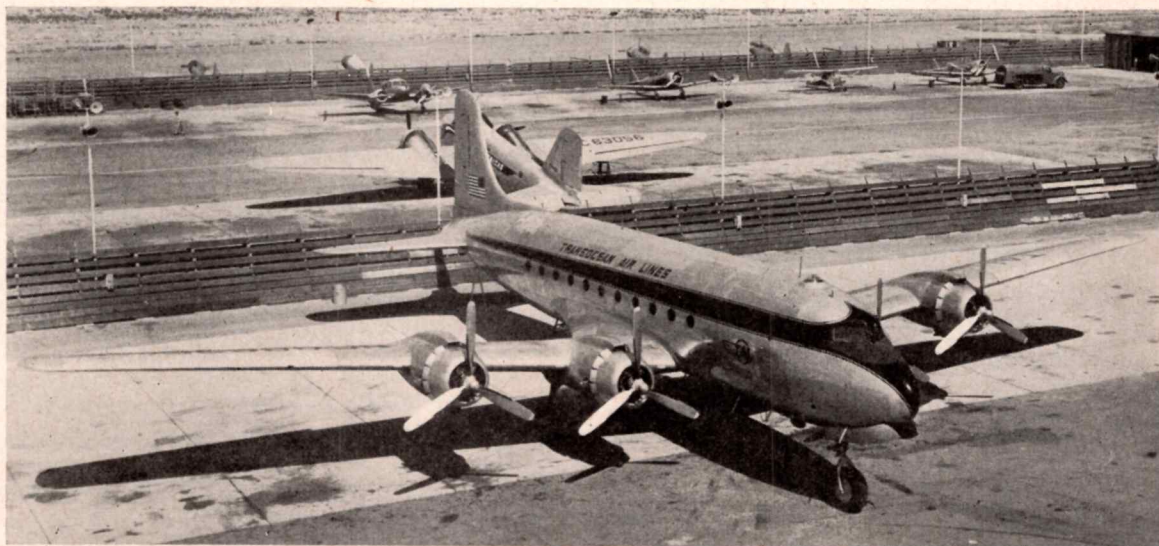
Use of Precision Parts Where Standard Parts May Be Used.—

In some instances, airframe manufacturers have used precision tolerance parts although ordinary commercial-tolerance parts could be employed. This imposes an additional cost for replacement and makes it necessary also for the maintenance facility to review all machine parts for use in maintenance replacement, or calls for the alternative of purchasing costly parts where normal parts might suffice. Airframe manufacturers may use precision parts, because these are standard as far as their fabrication operation is concerned, but they do impose an additional burden of cost on the air-cargo operator.

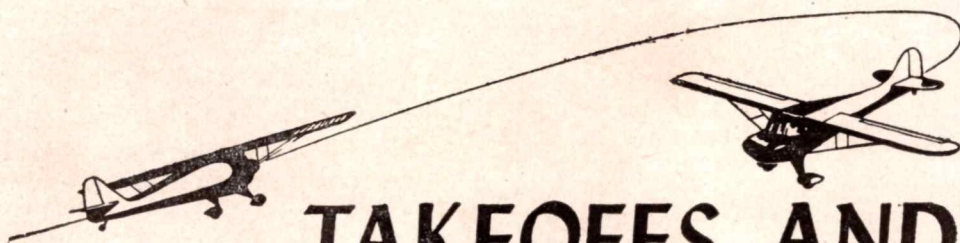
Use of Standardization in Small Parts.—

It is quite probable that a review of the small parts used in an air transport would reveal that numerous parts have but slight variation in size, length, or type of screwhead, etc. If a more thorough detail design was made of the parts, it would be found that many odd sizes could be eliminated, although it may involve a very minor weight penalty or require some slight redesign of the part. But think of the freedom from the aspects of material control, inventory, investment, Kardex records, purchasing, handling, shortage control and storage, which may be eliminated at a maintenance facility, and it would also simplify the airframe manufacturer's similar problems as well. It is safe to say that all avenues of design have not

(Continued on page 96)



Douglas C-54 converted into a passenger transport for Transocean Air Lines, of which AEMCO is a subsidiary



TAKEOFFS AND TURNS

Ground Refueling

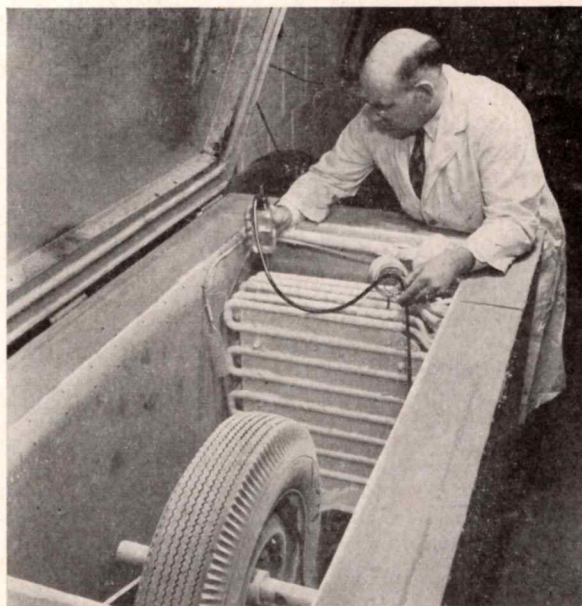
A new single-point refueling system developed by Boeing Aircraft is cutting 75% from multi-engine aircraft refueling times. Developed primarily for military operation, it uses the principle of forced feeding and permits a B-50 *Superfort* to be fueled by a single truck from one inlet point in a little over 15 minutes, in contrast with the hour it used to take for two trucks to accomplish.

Media

September issue of *Amphenol Engineering News* announces new all-service specifications for electrical connectors. Superseding the old AN-W-C-591b, the new specification is MIL-C-5015. Major changes are in marking and nomenclature . . . Dept. of Airport Development of the Port of N. Y. Authority has published a *Guide to Airshipping via The Port of N. Y.* giving complete information to shippers exporting by air, including rate schedules, inland routing and list of international carriers. . . . October issue of *AiReporter* celebrates the 10th anniversary of AiResearch Manufacturing Co., giving written and photographic history of company activities over past decade. . . . Convair, in cooperation with the USAF, has produced a documentary film titled *Target: Peace*, starring airmen of the Strategic Air Command and the Convair B-36; it will be exhibited to American Theatre and television audiences and, under State Dept. sponsorship, to the population of 23 foreign countries.

Education

Graduate School of Stevens Institute of Technology, Hoboken, N. J., is offering two courses in hydrodynamic design of seaplanes. . . . Parks College of Aeronautical Technology of St. Louis University has inaugurated a course in airport management leading to a BS degree in Aeronautics. Course is first of its kind sponsored by a recognized university and will be part of the School of Air Transportation. . . . Airline Mechanics Committee of ATA has outlined program for aviation technical schools, coordinating curricula for students specializing in airline maintenance. (Twenty-six leading schools in the nation already have agreed to follow the ATA curriculum) . . . Dr. C. H. Gray, head of RPI's English Department, has instituted a long-range program to relate practice in technical writing to various types of engineering. Plan calls for assigning English teachers to each engineering college at RPI for work with students in planning and revising term papers, theses and technical reports. . . . USAF School of Aviation Medicine has set up a Performance Physiology Laboratory to determine why pilots age faster than any other group of military personnel. . . . AAL has been awarded National Safety Council Trophy for producing the film *This Way Out*, judged the best motion picture in the field of occupational safety during 1948. Film depicts emergency procedures followed by DC-6 stewardesses, and is being shown at airline and military flight crew training schools.



Arctic Rubber

Firestone Tire & Rubber has discovered a synthetic rubber polymer that will bounce instead of shatter at $-75^{\circ} F$. At such low temperatures, GR-S and natural tread rubber tires become brittle, allowing pieces to chip out and developed permanent flat spots when parked for any appreciable length of time. Tests indicate that tires made of the new polymer will be resilient enough to remain serviceable at Arctic temperatures.

Aircraft Seats

Aircraft Div. of Weber Showcase & Fixture Co. announces the receipt of production orders for *Constellation* passenger seats from EAL & TWA, pilot & co-pilot seats from Convair and Fairchild for the B-36 and C-119-B; also USAF prime contracts for a long-range pilot seat and a new, 20-g crew seat.

Electronic Nerve Center

GE's Electronics Laboratory at Syracuse, N. Y., has developed a system for recording acceleration, turbine speeds, temperatures, stresses and pressures from rockets and guided missiles. Known as a *telemetering* system, it transmits 28 different kinds of data 35 times each second to a ground-recording unit, images being displayed on cathode-ray tubes.

Electronics Exclusive

Audio Products Corp. of Burbank, Calif., announces the discontinuance of its line of hydraulic devices. After an 18-month study of industry requirements, Audio Products has decided to concentrate all its research and production facilities on the manufacture of electronic and electro-mechanical equipment for the aviation industry.

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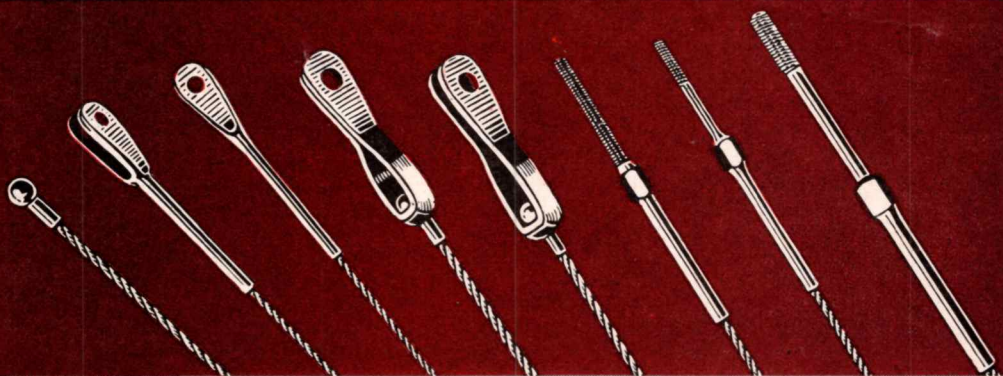
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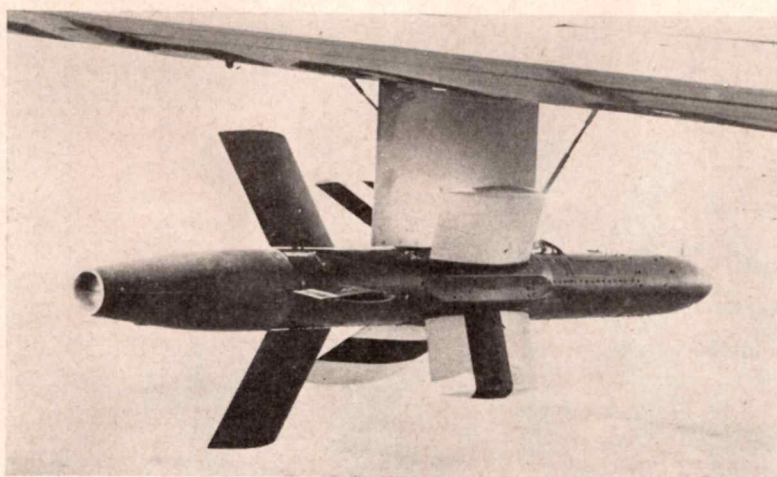


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FIRST AIR-TO-AIR MISSILE



THE rocket-propelled *Firebird* guided missile, virtually a fragmentation shell with human intelligence, which is extremely small, fast and difficult to track even on radar scopes, has been developed by Ryan Aeronautical Co. engineers. The Air Force's first air-to-air missile, the *Firebird*, is designed to be as effective for night or inclement weather interception as in clear skies, since visual sighting is not required.

Designated the XAAM-A-1 (Experimental, Air-to-Air Missile, Air Force Model No. 1), the Ryan *Firebird* is extremely compact for the complete radar navigational system and large explosive charge it carries. Launched from a "mother" jet fighter, it is capable of heading off and destroying its objective in a matter of seconds. It has all the speed generated by the parent fighter, plus the added power of its own booster rocket and finally its flight rockets.

Because it is a pilotless projectile, it is capable of maneuvers beyond human endurance, making it extremely effective against piloted aircraft. Little more than 6 in in diameter, it is about $7\frac{1}{2}$ ft long with a $2\frac{1}{2}$ -ft booster rocket.

The brain of the Ryan *Firebird* is its complicated radar navigational and electronic system, making this missile one of the most compact flying weapons ever devised.

The missile's mother plane is the first to detect the target, and directs the launching of the missile. Thereafter, the *Firebird* is designed to "home" on the enemy target. At night or in inclement weather, the launch plane must have a search/tracking radar capable of spotting the enemy aircraft. The fighter can carry one or more missiles on external launching racks which fit standard bomb installations. These missiles can

be fired in single or multiple launches.

In actual flight tests, four of the air-to-air missiles were slung beneath the wings of a North American F-82 *Twin Mustang* fighter—two beneath each wing. During other tests, a Douglas B-26 *Invader* served as the launch plane.

The wings and tail of the missile are in the form of a double cruciform. The four vane-like wings are located about midway on the rocket portion of the projectile. Two feet behind the wings are the four tail vanes. Both wings and tail surfaces serve to control the flight of the missile.

Of about 3-ft span, the wings have an aerodynamically smooth surface unequalled by the usual sheet-metal construction. Except for the plastic radome and wings, the basic missile

structure is conventional aluminum-alloy sheet.

After the missile is launched from the parent plane, a booster rocket takes over. Then, when the *Firebird* reaches maximum speed, the spent booster is jettisoned by an explosive charge. Thereafter, during the latter phase of interception, power is supplied by flight rockets. The warhead is designed to explode when it is close enough to any enemy aircraft to insure destruction. Should the missile miss its target, the warhead is automatically detonated in the air.

Development of the missile by the Ryan Aeronautical Co. has been under way for more than two years. The "Birds" have been manufactured by the company's San Diego plant and, under joint Air Force-Ryan technical supervision, actual firings have been made at Holloman AFB, Alamogordo, New Mex.

In the interest of economy, the missiles were launched from aircraft in flight without the guiding mechanism installed, and the data resulting from the flight tests served to determine the effectiveness of the propulsion system and the general aerodynamic configuration. The guiding mechanism has been subjected to extensive ground testing and found satisfactory.

The project is still in the experimental phase. Although it is not planned to put the *Firebird* into production, the research and development work has provided Air Force and industry technicians with valuable engineering data which is being used in designing improved air-to-air missiles. Cost of the development project approximated two million dollars.

AVIGATION RESEARCH

A DEVICE that will reduce in-flight delays by assuring landing-time reservations for aircraft is one of three major pieces of traffic-control equipment being developed under the common civil-military program of the Air Navigation Development Board, Chairman Ralph Damon reveals.

Making the first public review of the year-old interdepartmental board's work, Damon said that projects had been launched also for development of airport surface-detection equipment, to help controllers regulate traffic on runways and taxiways during bad visibility, and a radar, ground interrogation-air-reply system, by which controllers can determine aircraft identity, height, and location.

The development of airport time utilization equipment has been as-

signed to the Civil Aeronautics Administration, which will conduct the work at its Indianapolis Technical Development and Evaluation Center.

Airport surface-detection equipment will be developed by the Air Force at its Watson Laboratories, Red Bank, N. J., and the Transponder-Secondary Radar system, described by some as the answer to a traffic controller's prayer, has been assigned to the Navy Department for development by its Bureaus of Aeronautics and Ships.

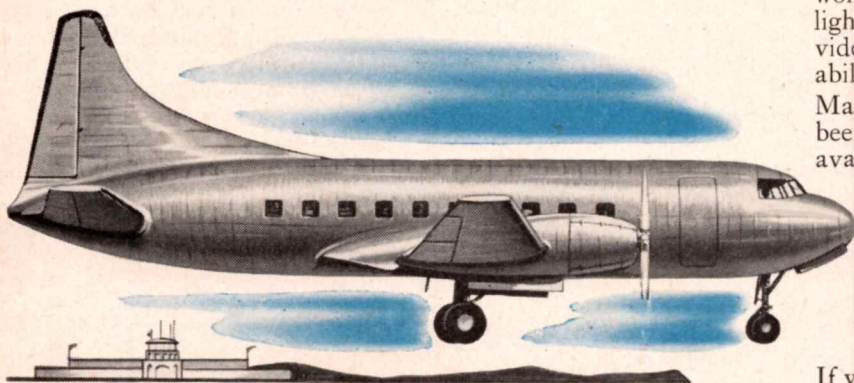
In addition to sponsoring development of new equipment, the ANDB has set up a program of evaluating existing or partly developed devices to determine whether or not they satisfy the operation requirements of the

(Continued on page 112)

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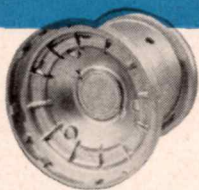
This is to be expected, since magnesium is the world's lightest structural metal—a full $\frac{1}{3}$ lighter than any other. And magnesium provides remarkable strength, rigidity and durability, as well.

Magnesium's successful use in aircraft has been proven by countless applications. All available forms—castings, forgings, sheet and extrusions—are utilized in landing gear, wheels, engine parts, skin, and in airframes. The proper use of this lightweight material can mean significant weight savings plus increased strength and rigidity wherever it is employed.

If you haven't already done so, it will pay you to consider magnesium carefully. To see how designers in a wide range of fields are using magnesium, send for your free copy of "How Magnesium Pays."

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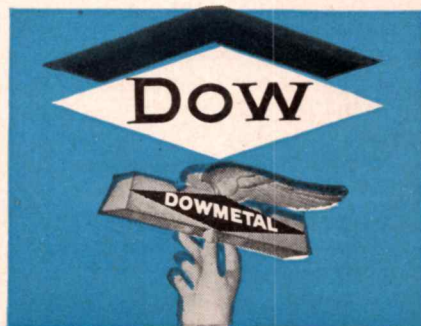


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A full range of aviation supplies should be stocked and attractively displayed by operators in order to obtain volume sales. Most manufacturers supply point-of-purchase displays and help with store layouts

The Private Market Is Here —FOR ACCESSORIES

GEORGE R. GALIPEAU

Vice-President, Van Dusen Aircraft Supplies

ONE of the unusual paradoxes of the present aircraft-sales picture is the fact that accessory sales for personal and executive aircraft are mounting in contrast with the decline of new aircraft sales in the past year or so. To the airport service operator this is very important. It means new profit possibilities in making sales to local owners.

Why, at this time, is the operator faced with an increased possibility of profitable sales to retail purchasers? Why is this odd situation in existence when other sales trends have either leveled off or are still a bit on the decline? It revolves around two basic factors—both of which give substantial encouragement to the entire future of non-scheduled business and pleasure flying.

In the first place, there is a more compact but much more substantial market potential for the sale of equipment which is designed to make flying more useful. The purchasers of war surplus aircraft never did represent a market for more than mechanical service. They bought equipment for 10 cents on the dollar, found that maintenance cost them dollar for dollar—and too many of them—and quickly got out or lost interest. Many others, who bought new aircraft immediately after the war, either found their "post-war pre-war" airplanes

lacked utility or they didn't have much use for an airplane anyway. As a result, these two groups of personal-aircraft users have pretty much disappeared.

The third group—businessmen and farmers who find a good solid utility in their airplanes—has thrived and grown in number. Its members have found that the newer, better-performing four-place aircraft in particular, have meant real utility, practical and economical transportation for busi-

ness, industrial and agricultural use. This group of aircraft users, numbering in the thousands, is a solid foundation on which flying, from now on, is to be based. It explains why accessory sales are showing such a healthy trend in the direction of private-owner purchases.

Couple this with the fact that there is now available a wide variety of new, highly useful accessories which make flying safer, greatly simplify navigation and give added performance to aircraft. This is excluding the wholesale nuts-and-bolts, fabric-and-dope business which makes flying more useful and practical, adds performance to aircraft, and also reduces maintenance.

The wise farmers and shrewd businessmen, who more and more are making up the bulk of the private-flyer group today, recognize the advantages of spending to get this increased performance and utility. That's why the smart operators are reaping increasing profits in this new private market.

Here are some examples: The hottest item on the market right now, and probably for some time to come, is equipment for utilizing the new system of omni-directional ranges now blanketing the country. This is, without any question, the most important advance in navigation for the private pilot that has come along since the invention of maps themselves. Omni gives the 50-hour pilot a "railroad" to almost anywhere.

The omni-receiver is so much better than any other radio-navigation device for the private owner that it certainly will be wanted as equipment by any plane owner who can possibly afford it. The demand will continue to increase as more and more people get an opportunity to fly with omni
(Continued on page 78)



Aircraft equipment and accessories are fast-selling items, but merchandising and sales promotion must be an integral part of any sales plan. Too many operators sell from stockbins instead of displays

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Designed and engineered to rigid specifications, American TIGER BRAND Control Cables are preferred for their high quality standards.

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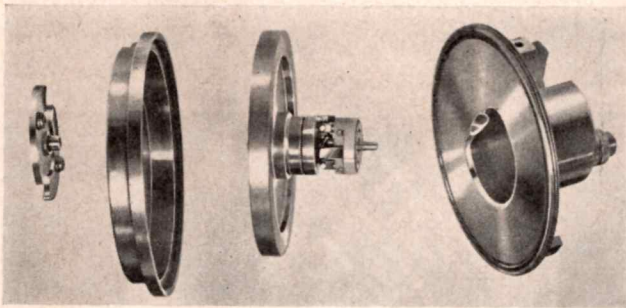
Our air-minded technicians welcome an opportunity to discuss control cables with you or will send you our latest manual on American TIGER BRAND Control Cables. Write or call our nearest office.

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AMERICAN TIGER BRAND CONTROL CABLES

UNITED STATES STEEL



"Hytrol" automatic brake-control system consists of a wheel skid detector (shown above), a control box, a solenoid-operated 3-way hydraulic valve and a pilot's control panel

BRAKE BRAIN

A NEW automatic aircraft safety-braking system, christened *Hytrol*, which reduces stopping distance an average of 33-1/3%—in some cases as high as 50%—and prevents skidding, has been developed by the Boeing Airplane Co. and is now being manufactured and sold by Hydro-Aire, Inc., Burbank, Calif.

Aviation and Government officials who have viewed this "anti-skid" system in action say it will have far-reaching effects on both military and commercial aircraft as well as on the air-minded public. In addition to its no-skid and short-stop advantages, *Hytrol* greatly increases tire life, with a corresponding decrease in maintenance time. It allows large aircraft to make emergency landings on small airfields and on any type of runway, including cement, asphalt, sod or gravel. It also cuts landing time to a minimum, since planes can land and stop in a far shorter distance and turn off the runway sooner.

Skidding tires have been the curse of airplane pilots for years. A locked wheel skid of four or five seconds duration is enough to ruin any airplane tire and usually suffices to cause a blowout. Warning devices have been tried, such as lights that flash on to tell the pilot that his wheels have locked and his tires are skidding; but they have proved unsatisfactory because, on an average landing, there is less than ten seconds for the pilot to adjust his braking pressure effectively and, too, there is the normal time lag in pilot reaction after the warning device has operated.

Hytrol proved itself on fully loaded cargo and passenger aircraft, as well

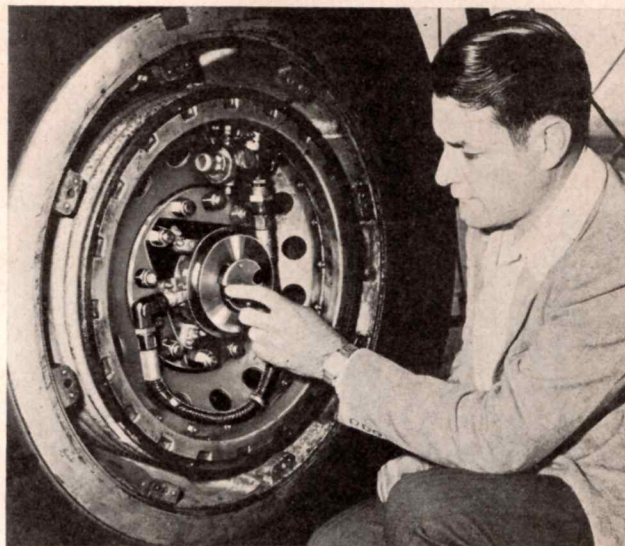
as Boeing's XB-47 *Strato-jet* where brakes are the sole means of stopping the plane. Characterizing *Hytrol* as an "automatic braking brain," Hydro-Aire's vice-president in charge of engineering, J. H. Overholser, says it eliminates all human error in braking an airplane, giving instant, positive operation under such variable conditions as wet, muddy or icy-runways, tire pressure or wear, weight or speed of plane, and pilot-landing technique.

Overholser points out that the need for an automatic safety braking system has increased in direct ratio to the increasing size and speed of aircraft and will become practically mandatory on all jet planes. Even the most experienced pilots have difficulty sensing tire skidding during the landing roll. Skidding, and the ability to detect it, is even more critical immediately after touchdown when the plane is still partially airborne.

The Fear of Skidding

Because inadvertent skids can take place without the pilot's knowledge, there is normally an over-cautious use of brakes to prevent them, and this increases minimum runway requirements. In an emergency landing, the pilot invariably over-brakes so as to stop the plane quickly and hasten removal of the passengers; this over-braking practically always results in tire blowouts. Still another hazard curbed is the case of a plane running into trouble on the take-off. *Hytrol* quickly decelerates and stops the plane before it runs off the field.

This system provides each wheel with its own braking circuit. The heart and brain of *Hytrol* is a skid de-



Method of installation of skid detector and hydraulic system on landing wheel. Detector incorporates a rotary inertia mechanism to detect angular deceleration

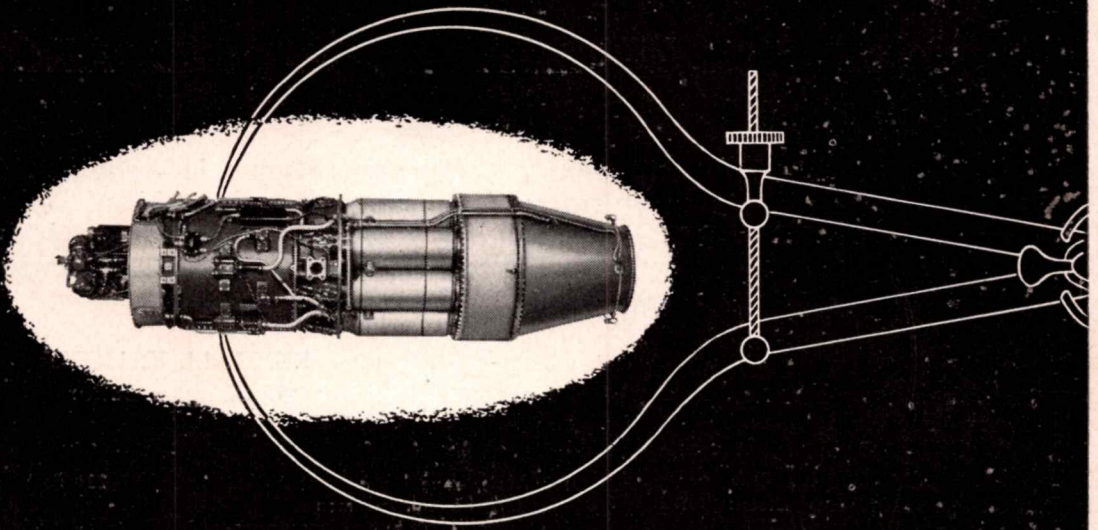
tector incorporating a rotary inertia mechanism that is set to detect angular deceleration of the wheel just greater than the maximum possible non-skid deceleration. The skid detector fits into the axle of each wheel. Braking applications are made at the rate of two to four cycles per second so that no intermittent effect is felt, but maximum braking power is held nearly constant.

Three and a half years of development and flight testing of this device show that braking efficiencies approaching theoretical minimum are attained. The system incorporates a "fail-safe" provision so that in case of mechanical or electrical failure the pilot would still have full use of his brakes minus the anti-skid feature.

In addition to the skid detector, *Hytrol* has three other principal components—control box, especially designed solenoid hydraulic valve, and a pilot's control panel. The pilot retains full control of the brakes up to the point of causing the tires to skid, at which instant the *Hytrol* mechanism takes over. It prevents locking of the braked wheel in the event that excess brake pressure is applied by the pilot, and also operates in cases where the wheel is entering an incipient skid condition. Through its skid detector it controls release and reapplication of braking pressure at lightning speed. Recovery from the skid is accomplished before the wheel has entered a full skid condition.

Actual operation of the automatic safety braking system is briefly as follows: As the braked wheel decelerates in the incipient skid condition,

(Continued on page 82)



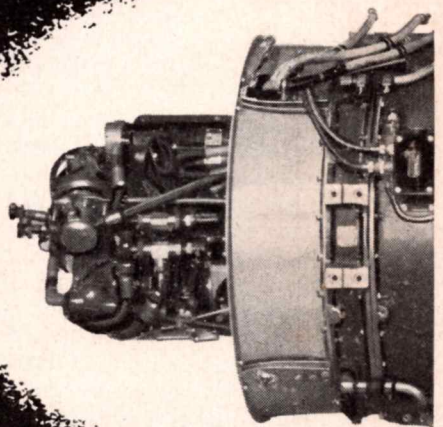
SAVES SPACE

Allison provides 5,000 pounds' thrust in a smaller diameter than any other engine.

Allison jet-powered airplanes:

Lockheed F-80 and TF-80 Shooting Star
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 Northrop F-89A Scorpion
 North American FJ-1 Fury
 Lockheed F-94
 Consolidated XP5Y
 Northrop RB-35B Flying Wing
 Martin P4M-1 Mercator
 North American AJ-1

J35 Axial-flow Turbo-Jet



Allison

Builder of axial and centrifugal flow turbine engines

DIVISION OF



**Indianapolis,
 Indiana**



LEGISLATION PASSED AND PENDING

When Congress returns in January, there are some unfinished aviation bills. Many other urgent items from the 1948 air policy reports remain to be undertaken. No better year than '50

KENDALL K. HOYT

Washington Editor

THIS is a review summary of work done for aviation by the 81st Congress in its first session, and a more detailed outline of legislation pending for the second round, beginning in January.

In 1949, despite large appropriations, air-power-in-being has taken a net loss. Procurement of new planes is being cut rather than expanded as the facts behind the air-policy reports demand.

Despite a propitious start last January in House support of the 70-group Air Force, the program has been impeded by doubts and controversies. Not even the news about Russia's atomic explosion seemed to count for much at the end. It only can be hoped that confusion has been cleared enough to see the shape of the big job ahead more plainly.

To the credit of the first session, a wide variety of minor bills, at least, came through, plus authority for several major programs—on paper, that is. The money is yet to come.

Since follow-up will be required for many of the new public laws, as well as for bills not yet completed, a careful reading of the whole list is invited.

Of 440 bills and joint resolutions which went the final way to enactment since the 81st Congress began, the following are of direct or indirect interest to aviation. For emphasis, we have double-starred (**) the main aviation measures. Single asterisks (*) mark the important general measures of aviation bearing.

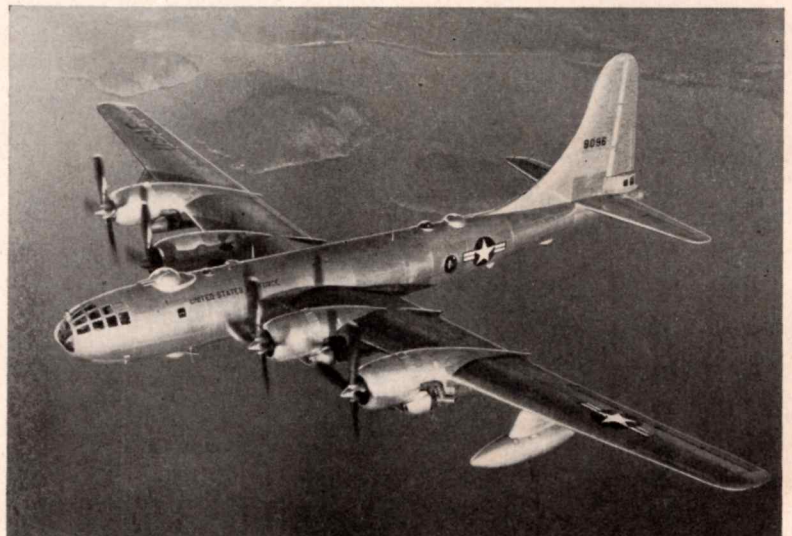
Public Laws

- **30 Air-warning and control network, Air Force, authorize
- 35 Travel via Newfoundland, tax exemption continued
- 36 Under Secretary of Defense, create job
- 51 Alien fiancées of U. S. service men, admit to U. S.
- 58 General of the Air Force, authorize grade
- **60 Guided-missile test range, Air Force, authorize

- 103 Pilots, repeal requirement that 20% be enlisted men
- 108 Reserves, death and injury benefits
- *109 Government reorganization authority
- *110 Central Intelligence Agency, provide for administration
- 167 NACA, authorize 10 professional and scientific positions
- 177 Fair Labor Standards Act, amend
- 183 Federal Airport Act, 10% limit on increase of maximum obligation
- 186 Transportation of explosives by air
- 187 Federal Airport Act, minimum wages
- 209 Eglin Field, Florida
- *216 Armed Services unification powers, increase
- 224 Federal airports, part payment to contractors as work progresses
- 227 Federal airports, federal share, high-intensity lights, to 75%

- 231 Post Office Department research program, authorize
- 274 CAA transportation of supplies, Alaska
- **277 Air star routes authorized where mail delivery is hard by other means
- 297 Army-Air Force retirement benefits
- 298 Logan International Airport, Boston, authorize \$600,000
- 311 Airport property, surplus
- *329 Foreign military aid, authorize
- 342 Active-duty status, certain Army and Air Force officers
- 345 Eglin Field reservation
- 347 Atomic Energy Commission, Military Liaison Committee, include USAF
- *351 Armed Services pay raises
- *352 Public works planning, exclusive of housing, \$100 million authority
- *359 Government salary increases, including various aviation officials

(Continued on page 106)



New Boeing B-50D "Superfortress" is equipped with two 700-gal external fuel tanks. Tanks are droppable and can be replaced by two 4000-lb bombs. New version has a speed of over 400 mph, bomb capacity of 28,000 lbs and range of more than 6000 mi.



Empire



Piedmont



Lamsa (Mexico)



Aerovias Reforma (Mexico)



Hawaiian

ALSO:

Braniff	Eastern	Trans Texas
Capital	Mid-Continent	United
Challenger	Northeast	West Coast
Continental	Pioneer	Western

5 more airlines join the switch to B.F. Goodrich brakes

283 DC-3s now operating more economically for 17 airlines

LAST spring, we announced that 12 U. S. airlines had switched 246 DC-3s to B. F. Goodrich brakes. Now five more airlines (above) have reported a changeover . . . and still others are on order.

Main reason is the lower maintenance cost—a benefit that will continue when these airplanes are converted to *Super DC-3s*.

The simple design of this brake eliminates many extra parts found in

other brakes. The only tools needed to reline it are a screwdriver and pliers. And the *full circle* braking action of the expander tube spreads wear evenly, lengthens brake life. Maintenance man-hours, "in-shop" time and replacement costs are all cut.

What's more, B. F. Goodrich Expander Tube brakes save weight. They can be designed lighter for a given amount of kinetic energy than any other brake. They cannot lock or grab. They respond smoothly—to minimum pressure. They take heavy overloads better in emergencies.

BFG assemblies—wheel, brake, tire and tube—offer special advantages for military and private planes as well as airliners. Standard assemblies are available for quick delivery and a new assembly can be engineered for any design on your drawing boards. Write to The B. F. Goodrich Company, Aeronautical Division, Akron, Ohio.

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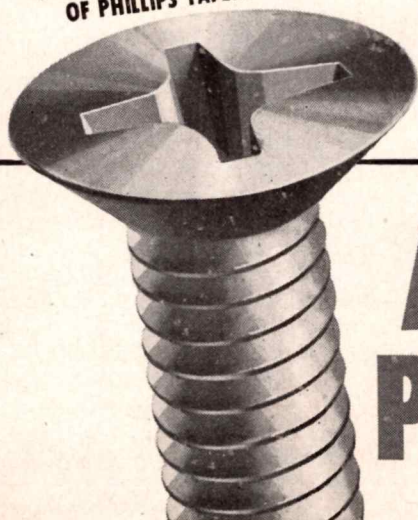
Yes, American Phillips Screws are one of the most reliable outward signs of built-in quality. And if *you* are concerned with the manufacture of any product, then you may well have a far happier New Year in store for you, if you will let us show you how . . . in your own plant as in all others . . . *American Phillips Screws always cost least to use.*

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OF PHILLIPS TAPERED RECESS**



**AMERICAN
PHILLIPS**

Screws



ALL TYPES
ALL METALS: Steel,
Brass, Bronze, Stain-
less Steel, Aluminum,
Monel, Everdur (sili-
con bronze)

A Practical Study of The Compressibility of Air for Aircraft Equipment Design

H. E. HEIGIS

Walter Kidde & Company, Inc.

THE National Bureau of Standards recently issued a publication containing charts on the compressibility of hydrogen, oxygen and nitrogen. These serve as a valuable reference in calculations involving the study of the compressibility of air, when interpolating on the basis that air is 20% oxygen and 80% nitrogen.

But, in the practical application of the compressibility of air to pneumatics—so important in the design and operation of aircraft equipment—it must be understood that air is far from a perfect gas.

There is no reliable published information, as far as the writer knows, dealing with the compressibility of air under varying conditions, which can be relied upon in calculations necessary to actual equipment design. The following calculations and conclusions may be helpful in such work:

The basic equation for perfect gas, of course, is as follows:

$$PV = nRT \quad (1)$$

The term "Z" is used to represent the compressibility factor and it is added to the above equation as follows:

$$PV = Z_nRT \quad (2)$$

Of course, in perfect gas, Z will equal 1.000 regardless of temperature or pressure, but in imperfect gases Z will vary from the unity value, and the variation will cover quite a range, depending on the temperature and pressure.

The problem of pneumatic operation can be handled best by the following formula, which is derived from (2):

$$\frac{P_1 V_1}{Z_1 T_1} = \frac{P_2 V_2}{Z_2 T_2} \quad \text{or} \quad (3)$$

$$V_1 = V_2 \times \frac{T_1}{T_2} \times \frac{P_2}{P_1} \times \frac{Z_1}{Z_2} \quad (4)$$

We are concerned first with the conditions in the cylinder at the charging temperature and pressure and the following table covers this range:

TABLE I

Z for Air at 70°F.

psi (Absolute)	Z _{air}
1700	.997
1800	.996
1900	.998
2000	1.001

The final temperature and pressure for operation is of importance and the most critical temperature generally discussed is -65°F. Of course, depending on the requirements, this terminal pressure at the end of pneumatic operation may be practically anything the designer chooses to make it (depending on force required and piston area) and, therefore, quite a range of pressures will be covered in Table II, giving the compressibility factor at -65°F. and various terminal pressures.

TABLE II

at -65°F

psi (Absolute)	Z _{air}
200	.978
300	.968
400	.957
500	.948
600	.936
700	.927
800	.919
900	.911
1000	.903
1100	.897

It is interesting to note that the factor can be less than .9 which indicates that the variation from perfect gas is 10% or even more.

There is also need for data showing the relationship between temperature and pressure as a normally charged cylinder is subjected to a wide temperature range. Table III shows the conditions for a normal charging of 1800 psi at 70°F. (1815 absolute) and also for the occasionally used 2000 psi at 70°F. (2015 absolute).

It is interesting to examine an ac-

tual case to see the real need for use of the compressibility factor in order to get accurate results. For example, in a cylinder charged to 1800 psi at 70°F. the cylinder pressure at -65°F. (ignoring the compressibility factor) would be computed as follows:

$$\begin{aligned} P_2 &= P_1 \times \frac{T_2}{T_1} \\ &= 1815 \times \frac{460 - 65}{460 + 70} \\ &= 1350 \text{ psi abs.} \end{aligned}$$

However, the correct computation is as follows:

$$\begin{aligned} P_2 &= P_1 \times \frac{T_2}{T_1} \times \frac{Z_2}{Z_1} \\ &= 1815 \times \frac{460 - 65}{460 + 70} \times \frac{.8917}{.996} \\ &= 1212 \text{ psi abs.} \end{aligned}$$

Note: Z₁ is had from Table I.
Z₂ is had from Table III
(-65°F.).

Of course, the same figure could be determined by direct reference to the data sheet referred to previously.

A typical example applicable to an aircraft system might be cited as follows: Find the cylinder volume (charging pressure 1800 psi at 70°F.) to operate a piston having a 30 cu in displacement with a required terminal pressure of 500 psi at -65°F. Assume expansion to be isothermal (actually it is adiabatic but this is not relevant to this discussion).

This can be done in either of two ways as follows:

From the chart, it can be seen that a cylinder charged to 1800 psi at 70°F will have an absolute pressure of 1212 psi at -65°F. The volume of the cylinder is then, from Equation (4):

$$\begin{aligned} V_1 &= (V_1 + 30) \times \frac{T_1}{T_2} \times \frac{515}{1212} \\ &\quad \times \frac{.8917}{.948} \end{aligned}$$

$$= (V_1 + 30) \times .4$$

$$.4 \times 30$$

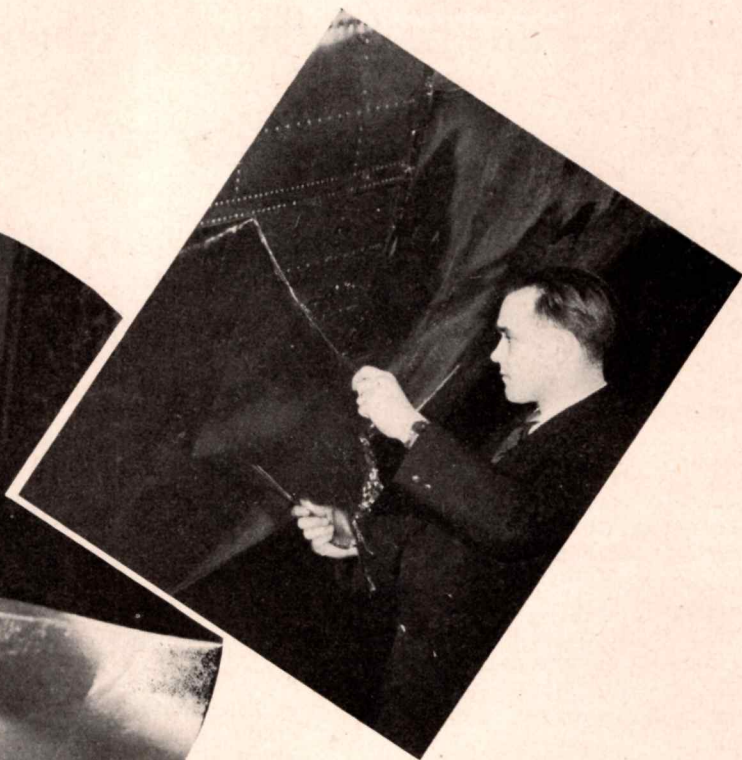
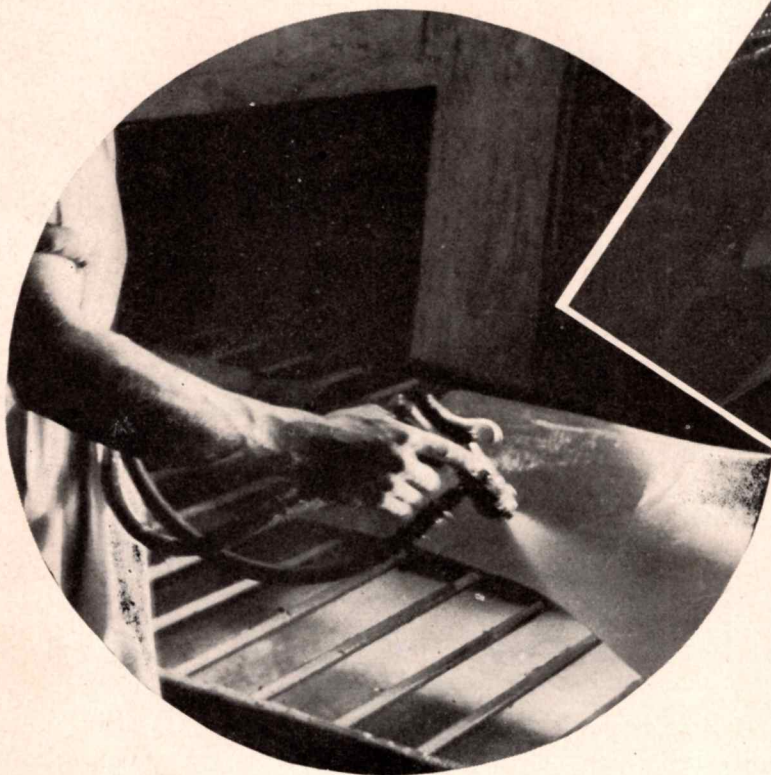
$$V_1 = \frac{.6}{.6}$$

$$= 20 \text{ cu in}$$

Note: Z₁ is had from Table III
(-65°F. 1212 psi).
Z₂ is had from Table II.

However, the computation can be

(Continued on page 37)



The beginning and the ending. Sheets are sprayed with "Liquid Envelope" upon receipt at the factory. Removal of the transparent plastic is equally simple; wide sections of the protective film can be pulled off in one sweep, leaving no bothersome bits around rivet heads

A TEST report of an aircraft manufacturer contained the following statement "Scratches and handling damage to aircraft skins in the shop are seldom of such serious consequence as to impair the structural integrity of the aircraft. But they are important influences leading to the rejection of completed aircraft, or the condemnation of sub-assemblies. As such, scrap due to inadvertent damage to work-in-process can become an important element in costs."

Every manufacturer of aircraft assemblies utilizing aluminum-alloy skins is plagued by surface damage invariably accumulated by a sheet from the time it enters the plant as stock until it is eventually riveted or otherwise joined to the assembly of which it becomes a part.

Better Finishes and Coatings, Inc., of Newark, N. J., appears to have provided an answer to the problem by use of its *Liquid Envelope*, a protective plastic coating which is sprayed upon the surfaces before fabrication and which is peeled off upon com-

SPRAYED "ENVELOPES"

PROTECT AIRCRAFT SKINS



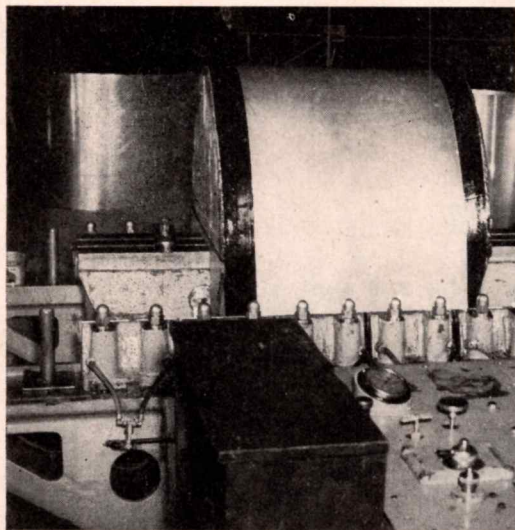
Photos Courtesy Canadair, Ltd.

Clamping and riveting of skin surfaces without leaving scratches and tool marks requires much care and patience. The plastic coating protects the surface, speeds the work and eliminates spot-burnishing after assembly

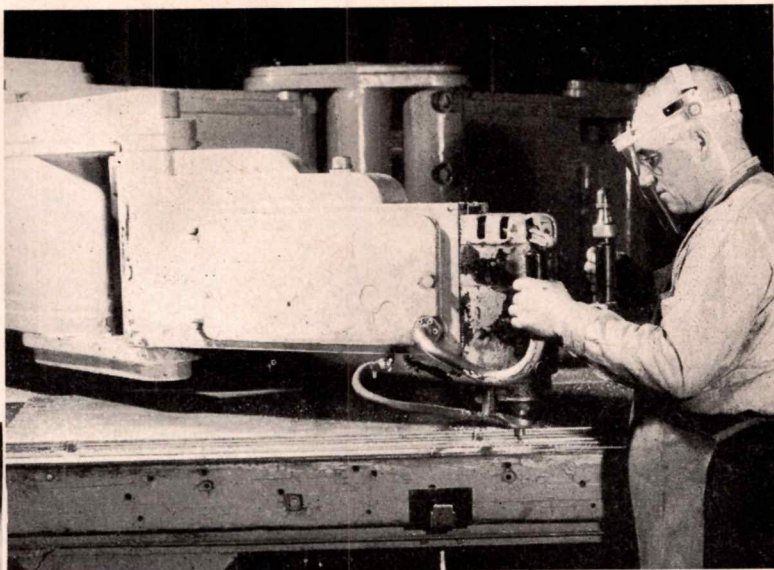
pletion of the assembly. The material air-dries fit for handling in from five to ten minutes, or can be cured faster by applying heat.

The accompanying illustrations are from photographs taken in the plant of Canadair, Ltd., makers of the *Canadair Four* transport. In this plant, *Liquid Envelope* is sprayed upon skin sheets upon receipt and provides protection through fabrication and assembly until the final cleanup of the plane.

The material is transparent and



Stretch-bending is a tough assignment for a plastic coating. 4-ft by 10-ft "Liquid Envelope"-coated aluminum sheet, clamped at both ends, is stretched approximately 4%



Plastic-coated sheets are piled on top of each other and routed four-at-a-time, with seldom a sheet marred. Savings on such operations are attractive from the standpoint of conservation of both time and material

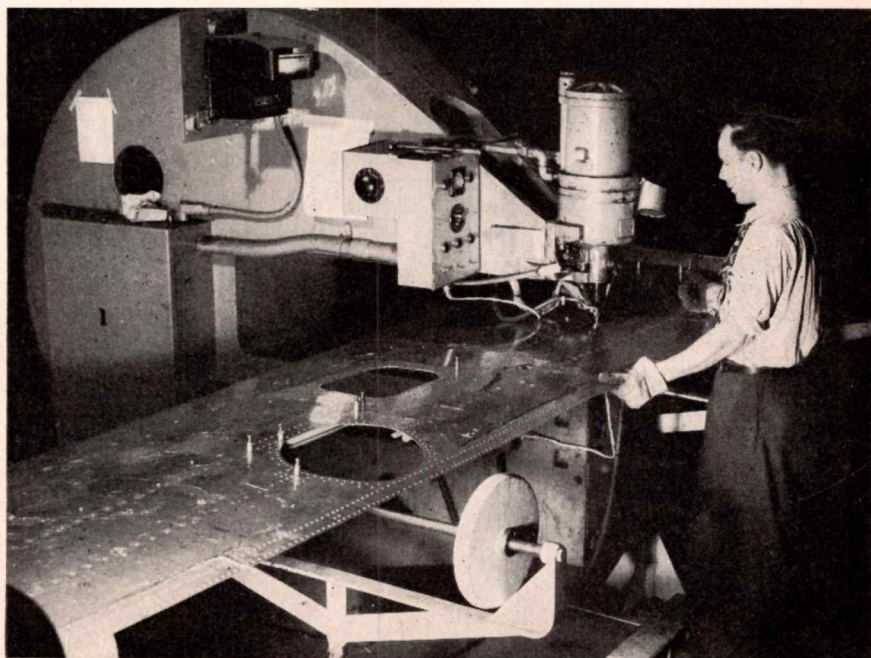
lbs. One heavy, wide-fan, cross-spray coat, with the gun held from 6 to 8 in from the work, applies a film of sufficient thickness. The material can be peeled off in large, wide strips.

In addition to its use on aluminum alloys, *Liquid Envelope* can be used for surface protection on stainless, clad, plated or pre-finished materials during fabrication, storage, testing and shipping.

amazingly durable. It holds up under such exacting operations as roll-forming and stretch bending, eliminating the high mortality of materials sometimes found in this type of fabrication. Skin fasteners, jig blocks and securing straps will not cut through it to mar the surface of the metal underneath. It is not removed for ordinary drilling, dimpling and riveting—being specified as satisfactory for faying surfaces, seams and under rivets. Canadair, however, peels *Liquid Envelope* off the seams of pressurized assemblies before riveting.

Sprayed plastic coatings have been used in the past to protect plastic canopies and for similar applications. However, the combining of toughness and flexibility with the proper adhesion for various materials in a sprayable film is an exacting science, according to Better Finishes and Coatings.

Canadair applies a .002-in coating to aluminum sheet. Standard, pressure-type paint-spray equipment is employed; fluid-line pressure is from 5 to 15 *lbs*, air pressure 80 to 100



Hot dimpling and riveting on a fuselage section, at a temperature of about 300° F, leaves the coating intact. Material is peeled back before riveting at Canadair along surfaces which become pressure-sealing joints; the plastic remains between surfaces of ordinary lap joints

Tale of a

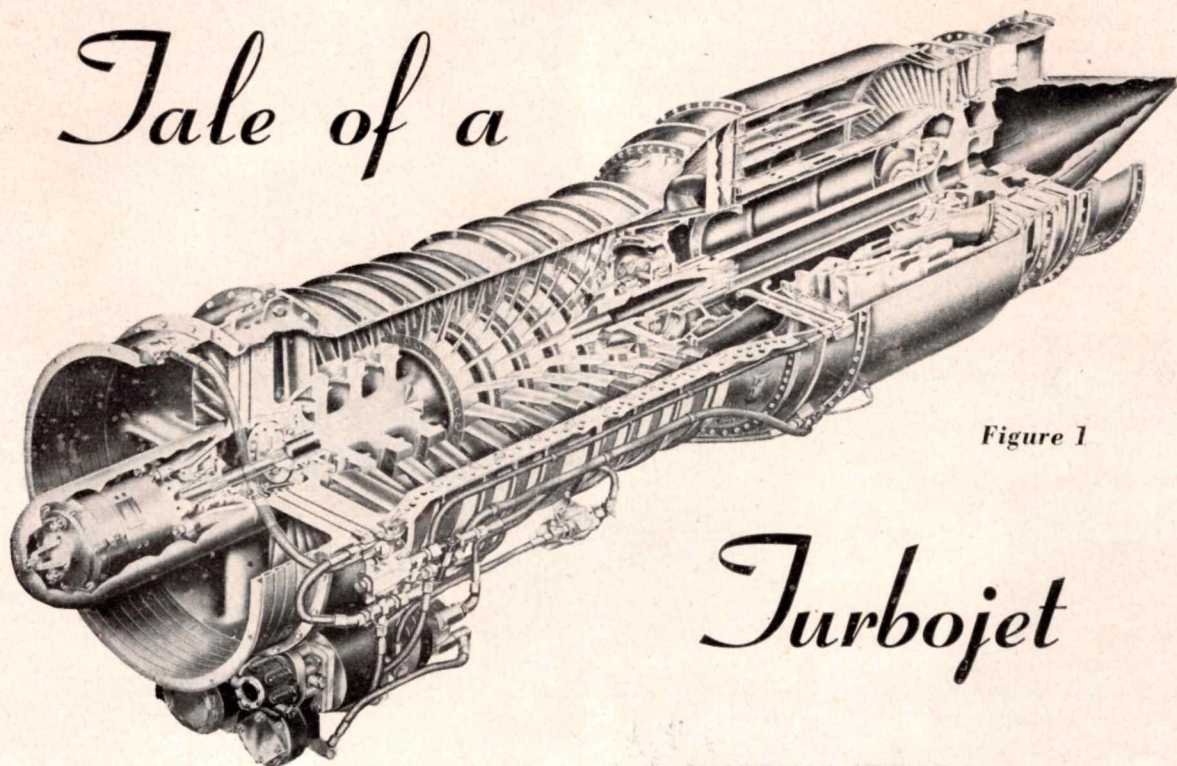


Figure 1

Turbojet

ROBERT L. WELLS

Design Engineer, Aviation Gas Turbine Div., Westinghouse Electric Corp.

DURING the past few months the U. S. Navy Bureau of Aeronautics has removed the veil of security regulations from the J34 turbojet engine designed and built by the Westinghouse Electric Corp. The J34, known also by its Westinghouse designation as 24C, is the powerplant used in the twin-engine McDonnell F2H *Banshee*. Several other Navy and Air Force planes in development or early production stages are using J34 engines. Among these are the Chance Vought F6U *Pirate* and F7U *Cutlass*, the Douglas F3D *Sky-Knight*, the McDonnell XF-88 *Voodoo* and the Lockheed XF-90.

The initial development contract for the J34 engine was let in the spring of 1944. Slightly over a year later, the first engine was operated successfully in the test cell. Development work continued rapidly and, in October 1947, the official 150-hour qualification test of the J34-WE-22 engine, the first production model, was completed successfully. The maximum performance guarantees for this model engine, exceeded by the qualification-test engine, were:

Thrust, 3000 lbs.

Specific Fuel Consumption, 1.08 lbs fuel/lb thrust.

Military Rotative Speed, 12,500 rpm.

Engine Weight (Including all engine accessories), 1200 lbs.

In the two years since this initial qualification test, two later models, the J34-WE-30 and J34-WE-34 have passed the qualification test successfully in accordance with the standard specification AN-ES-32.

In order to determine how much potential service life these engines have, the J34-WE-34 qualification-test engine, which had completed the full 150-hour test specified by the military services, was reassembled

for additional testing. It was subjected to a second, and then a third complete 150-hour test in accordance with the official qualification-test schedule. During the three testing periods, a total of over 495 hours of operation were accumulated on this engine. At the end of this testing, the engine was still in satisfactory condition and capable of continued running. This engine has once again been reassembled and is being used as a test engine for development work.

The J34 engine, like the earlier

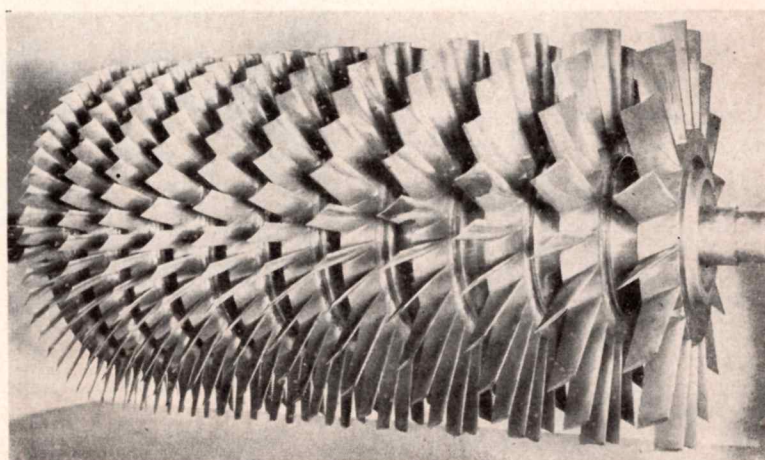


Figure 2

Westinghouse J30 and J32 engines, was designed to keep the frontal area to a minimum. The axial-flow compressor and the annular-type combustion liner are two of the design choices essential to the attainment of the low frontal area.

Air entering the engine passes through the helical-wound oil cooler and front-bearing support and is turned initially by the inlet guide vanes which are the forward-most components of the air-flow path. Passing through the axial-flow compressor, which has eleven stages, the air is compressed to approximately four atmospheres. The last components of compressor flow path are the straightening vanes which give the air an axial direction of flow as it passes into the diffuser.

The Three-Way Diffuser

In the fabricated stainless-steel diffuser, the air is divided into three annular paths. This air flows into the double annular combustion liner by passing radially through both walls of both annuli. Careful selection of the hole sizes in the combustion liner was necessary to achieve proper stability of the combustion process under a wide range of altitude and flight-speed conditions and also to permit achieving high combustion efficiencies. The fuel is introduced through nozzles, located at the upstream end of the two annuli, which protrude through holes in the combustion liner.

The temperature of gases leaving the combustor is the limiting factor in engine operation because of the effect of high temperatures on the turbine components. The hot gases pass through a two-stage turbine which extracts enough energy from the gas to drive the compressor and the engine-driven accessories. Downstream of the turbine, the gases flow through a fabricated stainless-steel exhaust collector and are then accelerated in a conical exhaust nozzle, which reduces the area through which the gases must pass. The exit velocity of the exhaust gases is in the order of 1300 fps.

The cutaway photo of the completely assembled engine in *fig. 1* shows the way the engine is mounted for test as well as the method of mounting in an airframe. Two trunnions are located on the diffuser housing. Attachments at these points take fore and aft loading, side loading, and part of the vertical load. The third point of support is at the front end of the engine on the cast front-bearing support. This is a universal joint which takes vertical loads only and permits axial expansion of the engine and distortion of the airframe

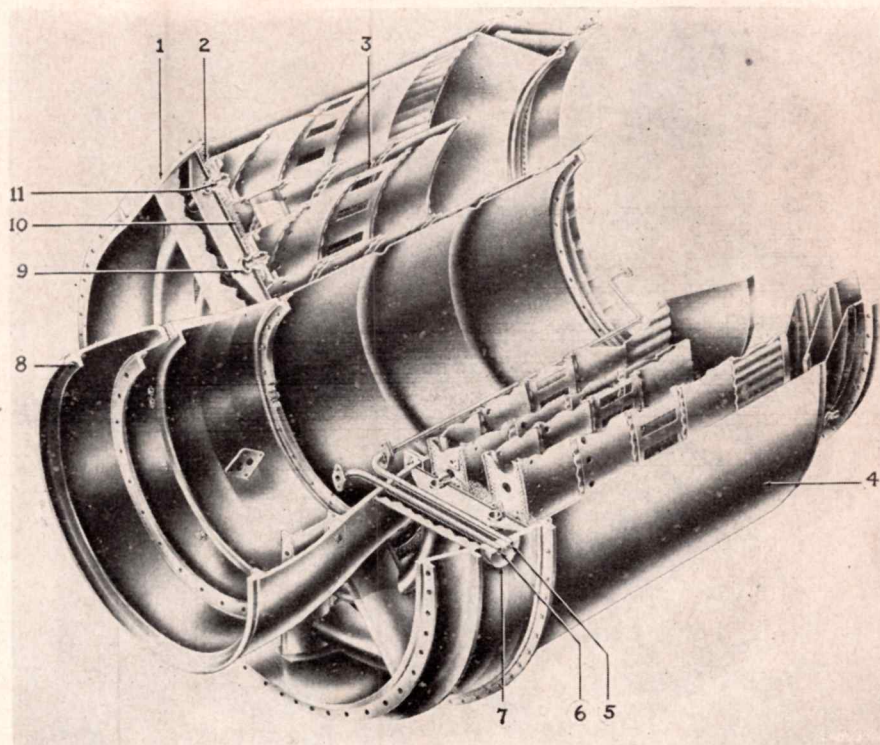


Figure 3.—Cutaway of the double annular combustion chamber. Air from the compressor first passes into the diffuser (1), a stainless-steel fabrication, where it is divided into three annular streams. The air then flows radially through both walls of both annular spaces that comprise the combustion area. The other index numbers, reading clockwise around the photo, are as follows: (2) the outer screen; (3) liner; (4) housing; (5) No. 3 bearing supply tube; (6) No. 2 bearing supply tube; (7) oil-supply boss; (8) compressor diffuser cone; (9) inner fuel manifold; (10) inner screen; and (11) fuel nozzle

between the diffuser and the front bearing support without imposing loads on the engine.

There is only a single rotating assembly in the basic engine. This is composed of the axial-flow compressor rotor, the long shaft extending through the center of the combustion chamber, and the two-stage turbine. This rotating assembly is supported on three bearings. One located at the front end of the compressor is a ball bearing that takes the entire thrust of this rotating element. It is necessary to take thrust loads in both directions because of reverse forces on the com-

pressor that occur under "windmilling" conditions. The other two bearings are roller bearings, one located at the downstream end of the compressor rotor and the other just upstream of the two-stage turbine. The use of roller bearings permits axial expansion of the rotating parts relative to the stationary engine parts. It should be noted that the two-stage turbine is overhung beyond the No. 3 bearing. This design has worked out very satisfactorily in actual engine operation.

The mechanical design of the engine parts is strongly influenced, of course, by the need for keeping weight to a minimum. Light alloys have been used wherever practicable/and, when ever ferrous alloys are used, the thicknesses are kept as low as is compatible with an adequate safety factor.

Oil Cooler

The forward-most component on the engine is the helical-wound aluminum oil cooler. The lubricating oil, on its way to the engine bearings, is pumped through the hollow rectangular tubing and is cooled as the air entering the engine comes in contact with the inside surfaces of the

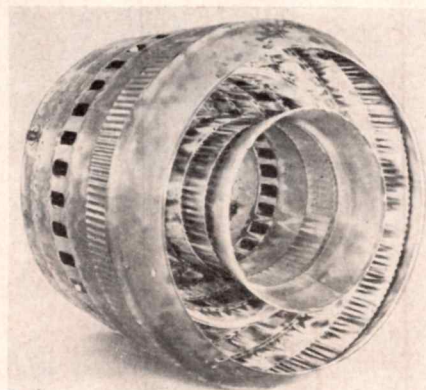


Figure 4

XF-85

LANDING-SKID DEVELOPMENT

McDonnell XF-85 parasite fighter shown after skid-test landing. Designed to fit in the bomb bay of a B-36, it has a wingspan of 21 ft and a length of 15 ft. Odd-shaped tail assembly is required for maximum flight stability

JOHN H. MEYER

Chief of Structures, McDonnell Aircraft Corp.

THE McDONNELL XF-85 has been something of a storm center since its inception. Controversy has revolved around several points; whether a barrel can fly; if so, whether it can be flown on and off a parent airplane (the B-36 in this case); if so, whether the fundamental idea of a parasite fighter is the correct solution for this tactical problem. The first two questions now can be answered in the affirmative; the last remains in the laps of the USAF tacticians.

Most of the development phases of the XF-85 involved bizarre problems and solutions. One of these was the emergency landing situation.

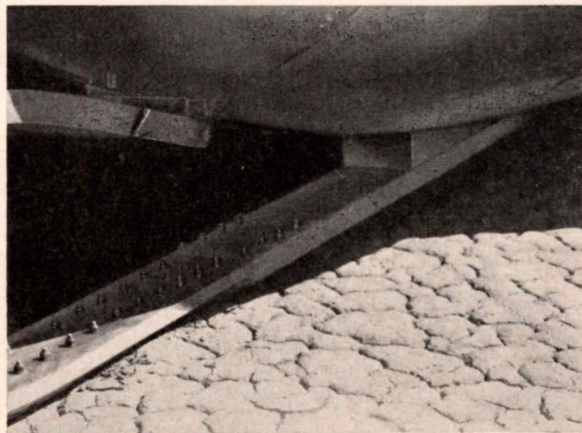
The engineering treatment and flight test results of skid landings will be discussed here.

Experimental airplanes always show odd quirks. In the early stages of design, it was presumed that some situation could prevent the XF-85 from making a successful hook-on to its parent airplane, so provision of a landing gear of some sort was considered. Retractable gear was out of the question—no room. Several arrangements were investigated; the one

finally adopted consisted of a broad ski-shaped skid down the center of the belly. This gear promised the most success for skid landings, as well as having less effect on the aerodynamic characteristics than a more elaborate gear.

The determination of the landing

characteristics for this odd landing-gear arrangement was the subject of considerable investigation. While it was known that the German ME-163 had made several successful skid landings, the XF-85 was higher off the ground than the ME-163. However, the ratio of skid length forward of the



View of the XF-85 nose skid, which is made of aluminum slightly harder than that used in the aft two skids. Skids are used in place of retractable landing gear because space is at a premium in this tiny parasite fighter. Nose skid extends along the forward belly centerline about halfway back to the tail

cg to cg height was about the same.

For design of the skid, a 12-in drop height was used. This was not used in the sense of determining a limit load, but as a means of determining how much energy the skid should be able to absorb without excessive deflection. The skid was made of 24S0 aluminum, since this alloy showed the best ability to dissipate the energy of drop without storing so much as to produce an objectionable bounce, along with sufficient strength to make the skid a reasonable size. Drop tests were made with a full-size skid attached to a steel fixture. The results were quite satisfactory, with the skid taking several inches of permanent set without failure or excessive bounce.

Method of Study

Dynamic analyses of landing behavior were made. The process consisted of a step-by-step calculation of the airplane response to the forces imposed on it during a landing, starting the calculation at the instant of impact and computing the pertinent force, time and space relationships until the end of the skid. Aerodynamic forces were accurately determinable, but of little significance. The force-space relationship of the skid with respect to the airplane was fairly accurately determinable, by computing the load-stroke characteristic from the plastic behavior of the skid.

The big unknown was the friction coefficient which would develop between the skid and Muroc Dry Lake bed. A friction coefficient $\mu = 1.0$ was considered an outside value. About 20 different skid runs were computed, using various values of μ , airplane angle-of-attack at impact, and airplane sinking speed at time of contact.

Calculations on a three-skid arrangement, with the aft skids well aft of the cg, showed that this arrangement would tumble. Calculations based on the final skid arrangement showed no tumbling of the airplane for any of the assumed boundary conditions. Of course, this could not be considered a guarantee of trouble-free landings, considering the unknown involved in the assumptions; but it was reassuring, since the possible conditions were fairly well bracketed. Some of the computed runs showed the skid flattening up against the fuselage and caving the fuselage in a few inches. For this reason, care was taken to avoid any detail design which might allow a part of the structure to break loose and dig into the ground during the skid run.

Stability in yaw was also considered. This was provided on earlier versions by having a nose wheel.

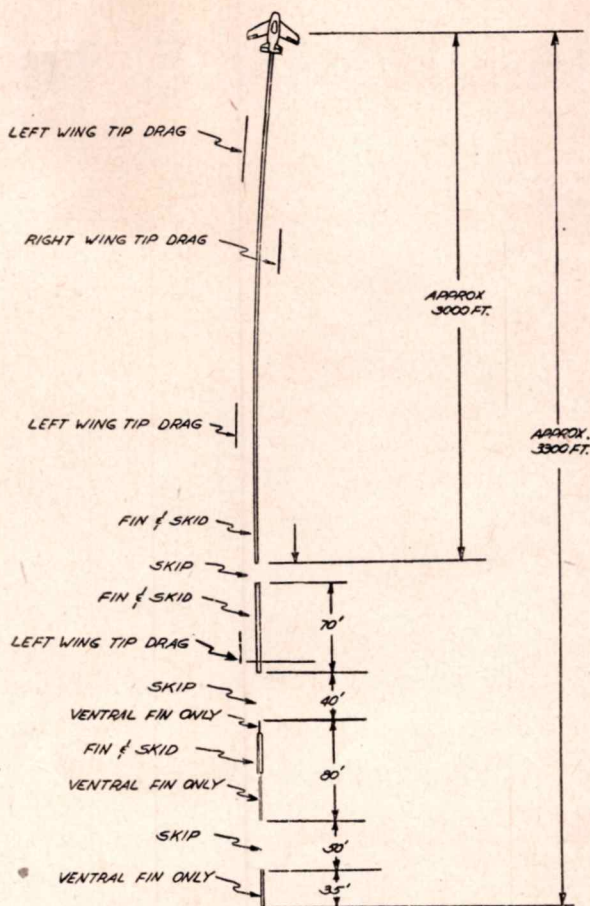


Diagram of test landing path for landing shown on opposite page. Four-point landings (fin, skid and both wingtips) are standard in parasite-fighter skid landings. Notice few skips occurring

Another version was made stable, having a forward skid of harder material than the aft two skids; the model tests bore out this stability measure. The centerline skid finally used was considered stable, although the source of this stability is not so clear as in the case of a tricycle gear with castering nose wheel.

To check the validity of the skid-run calculations, there was built a one-tenth scale model having dynamic similarity in the mass characteristics, skid stiffness, and tail stiffness parameters, which were considered the

major ones affecting pitching and yawing behavior during runout. The model was launched several times on a concrete floor. No tumbling occurred, except during one run with three skids and the main skids well aft of the cg. The skid permanent set was not as severe as predicated. The friction coefficient between model and floor was .4 for aluminum skids and .25 for stainless-steel skids. The friction coefficients were determined with the model moving slowly.

The final skid design took all the
(Continued on page 113)

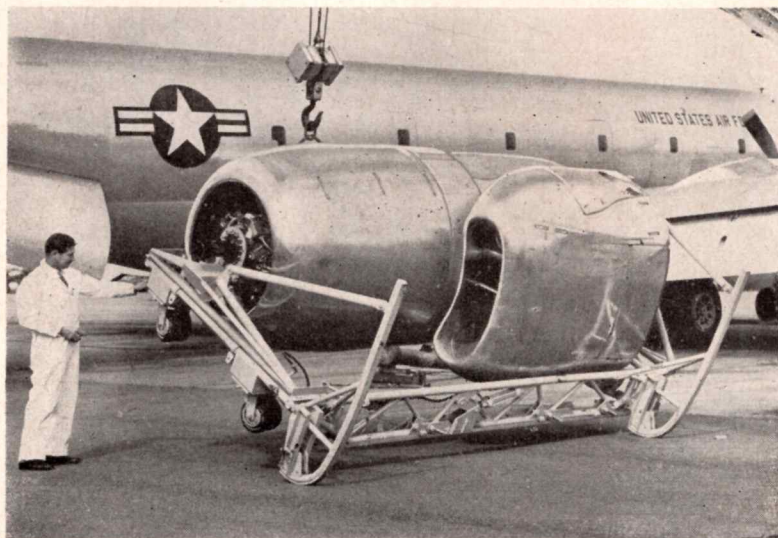
AIR MEETINGS AND EVENTS

December

- 8-11—"Wings Over the Nation" 11th Annual Celebration Sponsored by the Long Beach Chamber of Commerce. Long Beach, Calif.
- 9-10—Convertible Aircraft Congress Sponsored by Philadelphia Chapter of the Institute of Aeronautical Sciences and of the American Helicopter Society, Philadelphia, Pa.

- 15-16—Air Transport Assn. Annual Meeting. Carlton Hotel, Washington, D. C.
- 15-17—National Aviation Meeting Sponsored by the National Aeronautic Assn. Statler Hotel, Washington, D. C.
- 17—Institute of the Aeronautical Sciences 13th Wright Brothers Lecture. U. S. Chamber of Commerce Bldg. Auditorium, Washington, D. C.
- 31-(through Jan. 7)—Winter WingDing for
(Continued on page 112)

— MAINTENANCE TIPS —



Boeing Power Package

ENGINES on Boeing B-50 Superforts and C-97A Stratofreighters for some time have come in complete "packages" which include engine, turbo-supercharger, oil tank and system, all engine accessories and cowlings. Four mechanics can remove such an engine in 30 min.

A new portable mount has been de-

vised by Boeing to handle these "packages" after removal. Called an "air-lift dolly," its castoring wheels enable the mounted engine to be stored and transported with a minimum of handling. Of especial interest is its adaptability for loading, tie-down and unloading in connection with air-cargo transport.

Cold-Pressure Welding

AMETHOD of welding metals by pressure at room temperature, or cold-pressure welding, as it is called, has been developed by the General Electric Co., Ltd., of Great Britain. This process, controlled in the U. S. by the Koldweld Corp., can be applied successfully to several types of non-ferrous metal: aluminum, dural, cadmium, lead, copper, nickel, zinc and silver. At present, however, its most important application is in welding aluminum.

Aluminum surfaces must be entirely free from oxide film, which forms upon exposure to atmosphere. This film will prevent welding, but can be removed very easily. Once removed, satisfactory welds can be made several hours later, provided that the cleaned surface has not been contaminated by moisture or grease in handling.

In cold-pressure welding, the metal is made to flow away from the welding point as the tools are brought together. The rate of pressure application (slow squeeze or impact) does not affect the strength of the weld, but the shape of the tool is most important. Die wear, if any, can be counteracted by occasionally resetting the closure.

Three different techniques can be used in applying this new process: the *straight weld*, for box seams, sealing tube ends and other forms of lapped joints; the *ring weld* for sealing flanged tube ends, joining flanged tubes to plates for hose connections or

joining two discs to form air-pressure cells; and the *seam weld* for tube making and sheathed cables.

A new machine automatically and continuously scratch-brushes, forms welds and trims material. A roller welding machine can be used to seal folded edges and seam free edges of box-shaped sections.

Solvent Safety

DURING the summer, natural ventilation from open windows and doors removes some solvent vapors. However, in winter, mechanical ventilation increases in importance. It is suggested, therefore, that all ventilating systems be checked to make certain that they are adequate, functioning properly and in good repair.

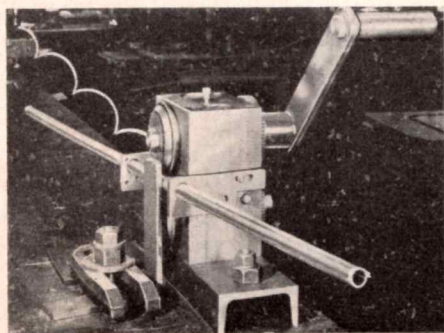
When solvent is used indoors, respirators are depended upon to prevent vapor inhalation. These, too, should be examined and, where canister-type respirators are employed, the service record of the canisters should be checked to assure that their contents have not outlived their usefulness.

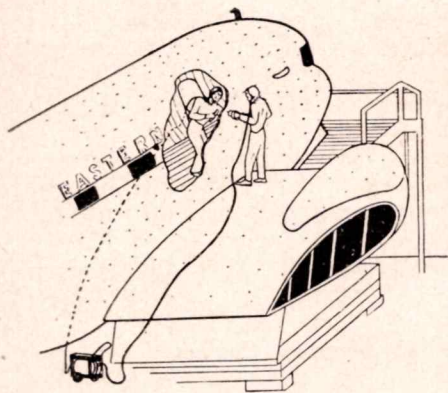
Because of the prevalence of dry, chapped skin during winter months, an increase in dermatitis may appear among solvent users. A good lubricating cream, provided near the washstand, will prove helpful in preventing such difficulties.



Jet Suction

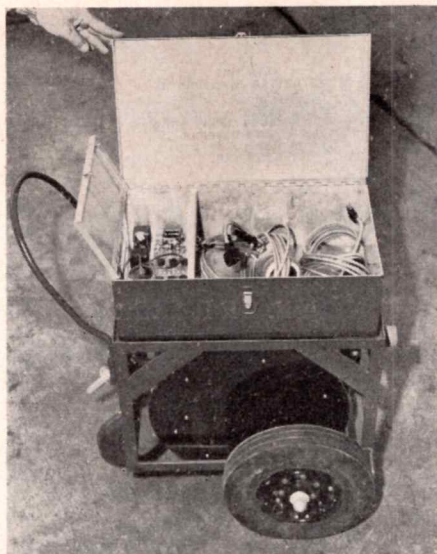
NORTHROP AIRCRAFT, INC., has developed a neat wire guard to be wheeled into position in front of air intakes on jet-powered aircraft. Mobile feature of the guard enables ground personnel to bring it into position before the aircraft is started and after it lands to protect ground crews from the powerful suction.





Mechanics' Intercom

A PORTABLE ramp intercommunication set has proved invaluable to Eastern Air Lines at their Miami maintenance base in speeding-up jobs requiring 2-way communication between mechanics, where the noise level is extremely high. Developed by EAL's Communications Dept., it is used chiefly between mechanics on sheet metal, electrical, hydraulic and rigging jobs.



It links any two working positions, such as cockpit-to-tail, belly-to-engine, or cabin-to-wing. The set is particularly useful under engine-noise conditions and is provided with a 160-ft self-winding cable, eliminating entangled slack around either working area.

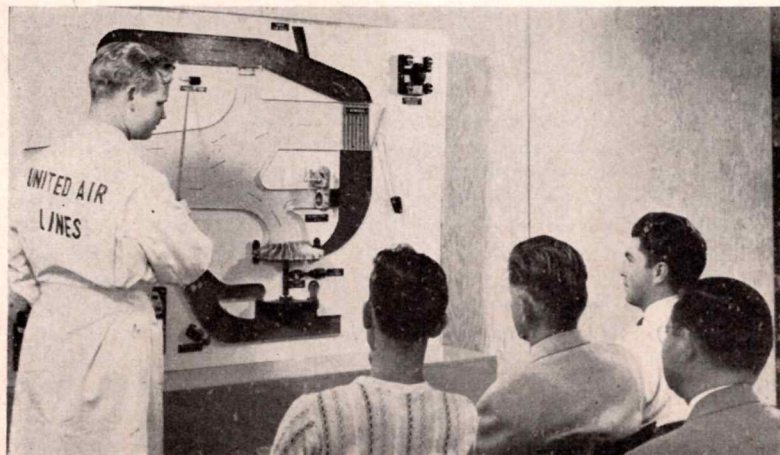
"Stratocruiser" School

MORE than 600 specialized employees of United Airlines are being trained to service and operate the seven Boeing *Stratocruisers* that are on order. Flight instructors, crews, mechanics and instrument technicians had several hundred hours' experience in all phases of the aircraft before the first one went into service.

Some 33,000 hours have been allotted for classroom study of mockups, photo enlargements and wall-sized charts and diagrams. Crews are familiarizing themselves with the plane at Boeing's Seattle plant and then returning to UAL's San Francisco Maintenance Base to instruct others.

Second officers (pilot-engineers) will receive 235 hrs training, plus 8-hrs cockpit check and 20 hrs flying time. Captains and first officers are receiving 70 hours classroom instruction, plus like cockpit and flight time. Engineers, production planners and supervisors range from 24-56 hrs; 462 veteran mechanics receive an aggregate of 22,700 hours training.

Mockups and cutaway assemblies are used as training aids in classes. Shown below is a mockup of the air-induction system, showing how cabin air is replenished fully with fresh air every four minutes. Also used is a full-size cutaway of the P&W R-4360.

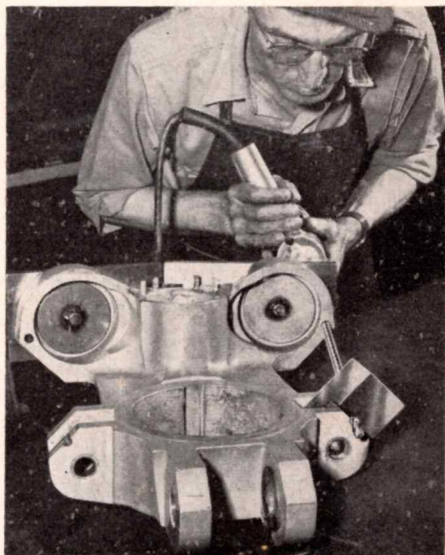


Lockheed Expands

LOCKHEED AIRCRAFT SERVICE, INC., has acquired the Willis-Rose Corp., aircraft maintenance operator at N. Y. International Airport (Idlewild). The Idlewild operation will now be coordinated with Lockheed's overhaul bases at Sayville, L. I., and Burbank, California.

It has been revealed that LAS is continuing negotiations with the Port of N. Y. Authority for the erection of permanent facilities, including new nose hangars, at Idlewild, in addition to the hangar and shop space now occupied by Willis-Rose.

Marc Worst, newly-elected vice-president of Willis-Rose, will directly supervise the Idlewild installation. It will continue to service KLM, Swissair, S&W, Aramco and El Al, the Israel National Airline.



Half-Holes Drilled

FORMERLY rasped out with a file, "half-holes" now are being drilled with an electric drill at TEMCO's Dallas plant. As a result, the time required for the operation has been reduced 50% and the holes themselves are cleaner and more uniform.

Half-holes are used as part of a Douglas C-54 nose-gear modification, and are cut out of the steering collar to make room for a tension bolt. The change in procedure was made possible by the development of a special drill jig, consisting of a steel plate and block which are attached quickly with locating pins to provide a 2-point guide for the drill.

Eliminating hand work, it does not involve excessive set-up time required to perform the operation on a mill.

Sand and Dust Erosion in Aircraft Gas Turbines*

J. E. DE REMER

Project Engineer, Air Induction Systems, Power Plant Laboratory, Air Materiel Command

ALTHOUGH the success of methods developed to meet the problems of desert operation is established for reciprocating engines, the gas-turbine powerplant presents new problems. The memory of the frantic, expensive, and necessarily rapid development of carburetor air filters during the war years is still fresh. The desire to avoid an occurrence of this sort of accelerated development with gas turbines prompted the USAF to investigate the vulnerability of this type of powerplant to desert operations.

The basic questions to be answered are whether there are any effects due to operation under sand and dust conditions that will result in operational hazards or require frequent engine changes, or, if there are no rapid gross effects, what kind of life and performance can be expected from gas turbines operated under desert conditions?

Due to the differences between the gas-turbine and reciprocating engines, the great amount of data concerning reciprocating-engine life and the vari-

ous effects of dust on that type of powerplant gives few clues as to what may be expected of gas turbines operating under dust conditions. The greater clearances of primary components in the turbines would appear advantageous. The higher rotational speeds and dependency of thrust on maintenance of certain dimensions would appear disadvantageous. Air-supply tubes to engine-mounted accessories such as generators, alternators, cabin-conditioning equipment and air turbines provide the means of dust entrance to this equipment, with possibly destructive effects.

The compressor would seem to be the most vulnerable component of the turbine engine, particularly the axial-flow type with its thin blades. The burners and fuel nozzles should not present much difficulty due to the higher-strength materials, large dimensional tolerances and the improbability of nozzle clogging. The nozzle diaphragm and turbine wheel, of higher-strength materials—thus less subject to erosion than the compressors—have critical surface contours and are more subject to failure, due to high operating temperatures.

The early-type bearing-lubrication system utilizing compressor air bleed for oil-mist lubrication presents possibilities of rapid and serious effects in the dust clogging of the air filters used in the system. Current integral-lubrication systems avoid this possibility. However, all compressor air-bleed lines are subject to sand collection and would impair services such as thrust balancing and cooling.

The general effect to expect in current gas turbines under dust conditions would seem to be a gradual deterioration of performance rather than extensive and rapid failure of components with the attendant hazards. Possible exceptions to this would be earlier failure in rotational parts, induced by dust erosion or compressor damage from poor airflow conditions occurring in an eroded duct system. Periodic checks on filters in compressor air-bleed lines would avoid the

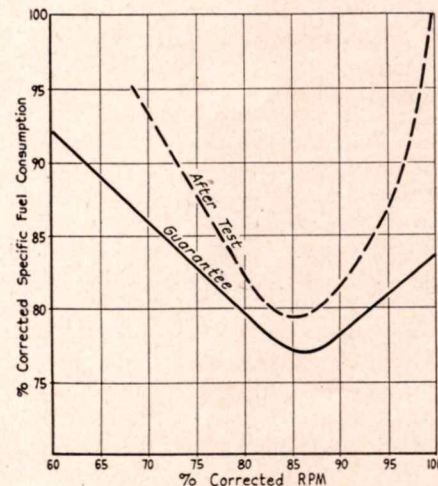


Figure 2

hazard of clogged balance or cooling air services.

The problem would appear to be one of measuring time effects in the deterioration of performance of the basic engine and securing data to be measured. Data on engine accessories must be obtained to determine their limits and filtration requirements.

The relatively limited operations of gas turbine-powered aircraft (particularly axial-flow compressors) has prevented any organized service testing of aircraft under desert conditions. Present tactical and operational procedures with gas turbines hinder an accurate evaluation of the severity of dust operations. A controlled test on a single aircraft, imposing dust conditions chosen from experience in the operation of reciprocating-engine aircraft, appears to be the only means of obtaining an idea of the problem.

The first test of this type was conducted at the Eglin Field Climatic Test Hangar during November, 1948, on a J47-GE-1 axial-flow turbojet installed in an F-86 airplane. The general test set-up consisted of a sand hopper and an injection tube into the inlet, and an air hose connected with it to blow the sand into the inlet.

The sand concentration injected into the engine was 1.36 lb/sec at

* Condensed from a paper presented at the SAE National Aeronautic Meeting in Los Angeles, October, 1949.

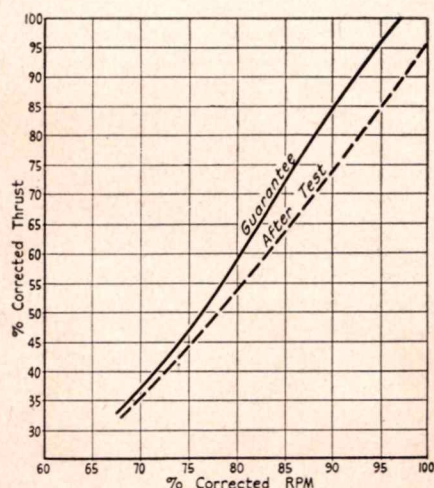


Figure 1

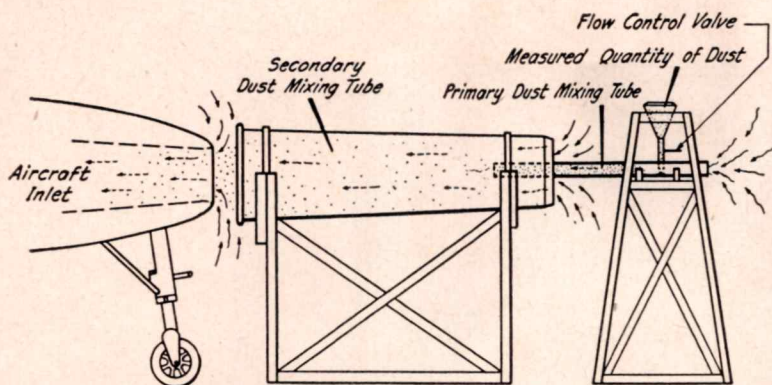


Figure 3

maximum rated power. This can be considered an accelerated test, in that the concentration of sand and dust was some 29 times the amount that would be ingested at the same power with dust conditions at the inlet as called for in Specification AN-F-30a.

The test was terminated at the end of a period of three minutes, under these conditions, when a circumferential rupture 3-in long and $\frac{1}{4}$ -in wide occurred in the exhaust cone 3-in aft of the turbine flange, probably induced by clogged burners. A total of 343.8 lbs of sand had passed through the engine.

A calibration of the engine, following replacement of the tail cone and mechanical inspection only, yielded the performance illustrated in figs. 1 and 2, as compared with guarantee ratings for the J47-GE-1.

Breakdown for Study

Following the calibration, a complete tear-down was made and the condition of the parts was noted. The starter-generator had severe commutator pitting and heavily-scratched contact surfaces of the brushes. The rear tips of 23 guide vanes caused V-type vibration marks on the gearcase-support segment of the forward frame.

The compressor-rotor blades were eroded severely at the blade tips and trailing edges. Erosion was moderate on all blade leading edges. The first-stage blades were bent at the trailing edges. All the anodizing surface treatment was eroded from aluminum spacers and wheel rims, as well as the dichromate surface treatment of the steel-wheel rims. The compressor-stator blades were eroded severely at trailing edges near the base in the forward stages.

Erosion was more severe and localized closer to the blade tips in the later stages. The compressor casings were eroded enough to indicate the pattern of airflow in the forward stages. The extraction air holes were

eroded, giving the circular holes an elliptical shape with the long axis parallel with the airflow. All the dichromate treatment was eroded from the magnesium casing and stator rings and from the magnesium midframe in the diffuser section.

The inner liners of the combustion chambers were in excellent condition. Several outer liners were discolored, indicating hot spots during the sand-test operation. The bellows in each outer chamber was full of sand, prohibiting free expansion and contraction of the chamber. The drain line of No. 3 and No. 6 combustion chambers was broken. The transition pieces indicated slight and uniform erosion.

All nozzle-diaphragm blades indicated slight erosion at the blade trailing edge, with excessive erosion of the outer-blade trailing edge behind combustion chambers 5, 6, and 7. The turbine buckets had uniform erosion of all blade tips inward for $\frac{3}{4}$ in on the convex side. Zyglo inspection of the wheel indicated no cracked buckets. The turbine shroud ring had three areas, 5-in long and $\frac{1}{4}$ -in wide, burned away behind burners 5, 6, 7, and 8. The exhaust cone had a circumferential burned hole, 3-in long and $\frac{1}{4}$ -in wide, 3-in aft of the

turbine flange behind burners 6 and 7.

A thorough inspection of oil lines, pumps, oil filters and bearings did not show any presence of sand. All balance air lines and air-cooling lines were packed with sand, permitting little or no effective airflow. The 1st-stage and 12th-stage compressor air seals were sand-blasted, but indicated only normal wear on rubbing surfaces. The sand that had collected inside the areas protected by the seals was in a fine powder form. The mid-frame and turbine-air oil seals indicated only slight blast effects. Static and dynamic balance of the compressor was unchanged by the dust erosion.

The Question of Speeding Up

The rapidity of failure of the J-47 engine during the Eglin Field tests brought up serious questions regarding the validity of an accelerated test. As a result, Air Material Command set up a similar test on a YF-84 airplane, using a J-35-A-15 engine, with the objective of duplicating actual operational conditions as closely as possible. After experimenting with several dust-injection methods, the arrangement illustrated in fig. 3 was accepted.

The large mixing tube is an F-80 exhaust tailpipe with the larger opening facing the aircraft inlet. The smaller mixing tube is a 3-in OD pipe. The low-pressure region at the aircraft air inlet produced airflow through both mixing tubes, the velocity dependent on the distance of the large tube from the aircraft air entrance. Turbulence produced in the large tube thoroughly distributed the dust over the entire aircraft air entrance, thus providing natural conditions without the need of auxiliary-power equipment.

The general test procedure used was to operate the engine to a power

(Continued on page 74)

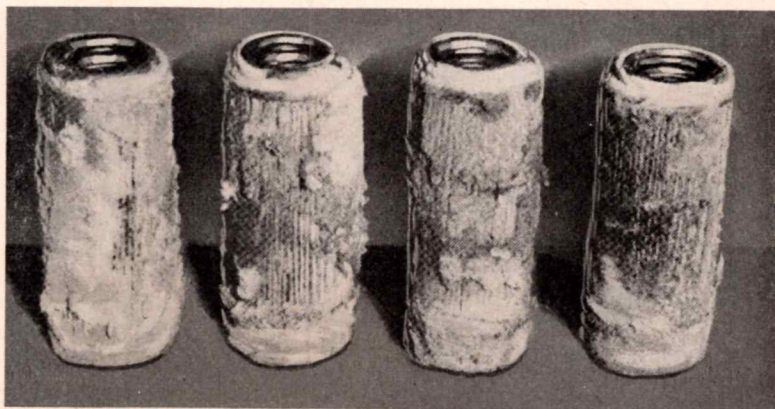


Figure 4



Interior view of DC-6A cabin, looking forward. Approximately 2/3 of the 66-ft cabin is visible in this illustration. Grid pattern of tie-down rings is noticeable on walls and floor, as are air vents

Evolution for Cargo

E. F. BURTON

Chief Engineer, Douglas Aircraft Co., Inc.

THE Douglas DC-6A *Liftmaster*, which made its initial test flight this past month, represents a practical expression of confidence in the future of the cargo industry. The first four-engine aircraft specifically designed for commercial cargo transport, it is intended to fill a definite need for a modern, high-density, medium-size airplane for both civilian and military use.

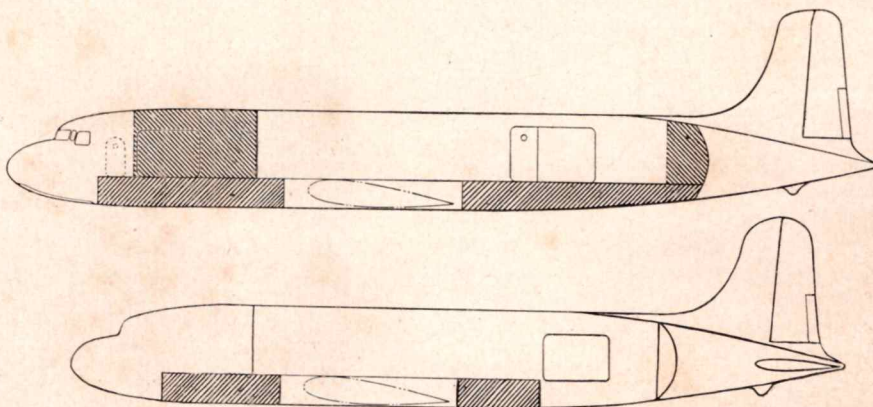
The DC-6A is a development of the DC-6 Series as the C-54 was a development of the DC-4 series. In accordance with Douglas practice in the construction of transports, the *Liftmaster* is an evolutionary development rather than a radically new aircraft design. Wherever it was practical to use proved aircraft structure and systems without compromising the purpose of the aircraft, this was done. However, the fuselage is entirely new and incorporates those design features which experience has shown to be necessary for successful and economical commercial and military cargo operation.

In the same sense that it is a development of the DC-6 passenger transport, the DC-6A is a forerunner of

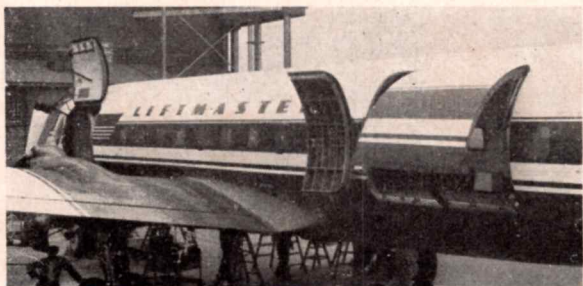
new airplanes to come. Definite plans have been formulated for the manufacture of the *Liftmaster* as a high-density passenger transport carrying 92 persons; a convertible passenger-cargo transport and as a luxury passenger transport, carrying 85 persons and a crew of six.

The DC-6A was designed specifically

as a replacement for the Douglas C-54 *Skymaster*, which is now the backbone of both commercial and military cargo operation throughout the world. Of the 1200 built, several hundred are still being operated by our air forces and many have found their way into commercial service. However, these aircraft have an average age of five



Scale drawings showing comparative size of the DC-6A (above) and the C-54. Note longer fuselage, greater main-cabin area and larger belly compartments. Shaded DC-6 fuselage sections denote greater cargo area in comparison with C-54. Door size is also to scale



Above—Douglas DC-6A on initial test flight. Aircraft is now on demonstration tour throughout the United States, being tested by airlines. Left—Both cargo doors are shown on this view of the DC-6A. The power cargo lift, which operates from the aft door, was not yet installed when this photo was taken at the Douglas plant. The aft door, partially closed, has an opening 78-in high and 124-in long

years and thousands of logged hours in the air, and are becoming "work-weary" to the extent that a replacement aircraft type is recommended at this time.

In many cases, C-54's now in commercial-cargo operation were obtained for a relatively low initial cost and have been written off the books as capital investment. It is difficult to design a new airplane to compete with the C-54 under these conditions; yet, it is obvious that a C-54 replacement must offer substantial economical advantages in order to justify a large capital investment required for a fleet of new aircraft.

Design Features.—The DC-6A provides many modern design features not incorporated in the C-54, which will result in greater schedule reliability, faster transcontinental service, reduced ground handling and loading time and a lower cost per ton-mile. The more important of these are cabin pressurization, radiant-panel heating, thermal de-icing, installation of reversible propellers and custom-engineered cargo facilities.

The advantages of thermostatically controlled, radiant-panel heating—which avoids cold walls and spotty heat distribution—are obvious in connection with the shipment of perishable or live cargo, such as flowers or baby chicks. Thermal de-icing, when

combined with cabin pressurization, makes the DC-6A an "all-weather" aircraft, capable of much greater schedule reliability; again avoiding unnecessary spoilage, as well as delay. Reversible propellers shorten landing distances, lower brake-maintenance costs and permit reduced ground handling.

Cargo Facilities.—The unique design feature, with respect to cargo operation, is the addition of a second cargo-loading door at the forward end of the main cargo compartment and the re-design of the aft loading door. The C-54 has a single door aft, which is approximately the same size as the forward DC-6A door. The inclusion of a second door increases the door area $2\frac{1}{2}$ times over that of the C-54 and provides simultaneous access to the forward, center and aft sections of the main cargo compartment. The after door is 78 in high by 124 in long and can accommodate a package approximately 75% larger than the maximum for a C-54.

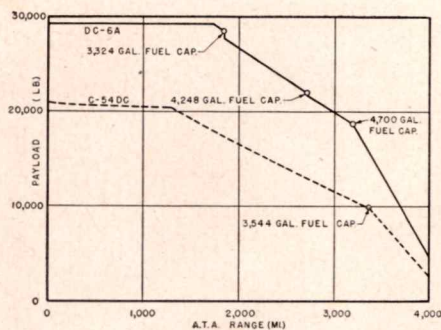
Both doors are hinged at the top and open upward, entirely clear of the loading area. There is available a platform lift unit that may be attached to either door to facilitate cargo handling. It is capable of raising a 4000-lb load from truck-bed height to the floor level of the airplane. A small door in the rear cargo door per-

mits entrance to the aircraft without opening the larger door.

This much-improved system will permit dual loading or unloading or simultaneous loading and unloading, thus greatly reducing ground and loading dock time. This means increased aircraft utilization and a lower investment in ground-handling equipment.

A cargo capacity of 500 cu ft is available in the DC-6A fuselage, which is almost 12 ft longer than the C-54 and 5 ft longer than the DC-6. This spacious interior permits varied densities of cargo loads and a well-balanced loading flexibility. With higher payloads, the natural spreading-out of the load inherently places the center of gravity in a desirable location. The main cargo compartment measures 4433 cu ft, the forward lower or belly compartment measures 267 cu ft and the aft belly compartment measures 300 cu ft. Both lower compartments are accessible through 37- by 45-in doors.

Adequate tie-down facilities are provided through ringbolts installed on the floor and cabin walls. The floor tie-ring is included in a fitting, allowing quick attachment of seats and litters, installed on a 20-in grid pattern for the full length of the main cargo compartment. A crash bulkhead is provided between the cargo and crew compartments, with a catenary, web-



Above is shown a comparison of the load of the DC-6A with the C-54 at various operating ranges. A 10-mph headwind is assumed

type safety curtain immediately forward of the bulkhead for protection of the crew.

Extensive design consideration resulted in a cargo floor that is waterproof and capable of resisting heavy abuse. It consists of four extruded-magnesium beams running the full length of the floor. The beams are spanned by corrugated panels covered with 75S aluminum-alloy sheet, which is, in turn, covered by an especially developed anti-skid plastic surface, .070 in in thickness. Tests indicate the great superiority of this type of floor over the plywood floors used on C-54 aircraft.

The interior of the DC-6A offers distinct advantages for cargo operation. The main cargo area is provided with an aluminum-alloy scuff plate, approximately 10-in high, extending from the floor around the entire periphery of the cabin. The balance of the interior lining consists of .042 fiberglass laminate sheeting, over sound and thermal insulation. The fiberglass lining, besides presenting a tough, abrasive resistant surface, also offers exceptionally good light-reflection characteristics because of its white surface.

Payload & Range.—The DC-6A cargo-compartment volume of 5000 cu ft is about 30% greater than that of the C-54. DC-6A weight-limited payload is approximately 28,800 lbs as against 21,000 lbs for the C-54. To achieve the weight-limited payloads mentioned, the DC-6A requires a cargo density of 6 lbs/cu ft, while the C-54 requires a density of 5.5 lbs/cu ft.

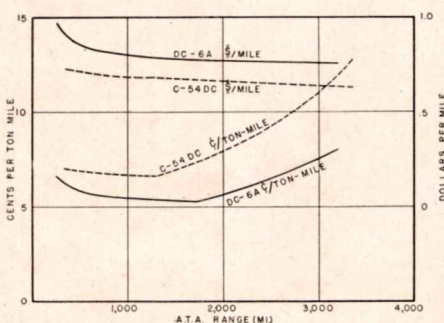
Due to the substantially increased range, one-stop transcontinental service is feasible with the DC-6A, while two-stop operation is indicated for the C-54 when capacity payload is carried. It is well also to note that the DC-6A, carrying the C-54 maximum payloads (21,000 lbs), is suitable for non-stop transcontinental service.

Cruising Speed.—Cruise alti-

tudes are selected so as to give the same cabin altitude (8000 ft) for the two airplanes, and the typical weights assumed in determining the cruising speeds are comparable. The DC-6A is from 70 mph to 105 mph faster than the C-54 and has an advantage of 90 mph at maximum cruise power.

Other than obvious advantages of lower cost due to faster schedules, the increased speed of the DC-6A is of particular advantage in a main-line cargo airplane. At C-54 speeds, overnight service between east and west coasts is marginal.

Trade practice—particularly in the retail-sales field—calls for most business enterprises to receive shipments in the morning before business hours and to ship in the afternoon and early evening after business hours. Since storage space is not available in high-



A comparison of cost per mile and per ton-mile for the DC-6A and C-54. A DC-6A initial cost of 3.6 times that of the C-54 is assumed

turnover retail markets, many will not accept shipments arriving too late to shelf before business hours. Similarly, after business hours, loading ramps are busy with outbound shipments. At C-54 speeds, many shipments bound from California to New York, or vice versa, require warehousing for one day before delivery, thereby increasing costs and the possibility of spoilage.

With the higher cruising speeds of the DC-6A, overnight transcontinental service becomes assured. A 40% increase in cruising speed will, in many instances, cut a full day from the effective coast-to-coast schedule.

Operating Cost.—The ton-mile cost advantage of the DC-6A is, of course, the significant factor in cargo operation. It is generally recognized that cargo volume is affected greatly by even slight changes in ton-mile costs. Thus, the 18%-better operating cost of the DC-6A should result in a great expansion of air-cargo transportation. The higher cost per airplane-mile of the *Liftmaster* is largely due to the higher amortization costs required.

However, the lowered ton-mile cost more than makes up for it. With relatively small increase in manpower and operating expense, the DC-6A can carry more than twice as many ton-miles per hour as the C-54.

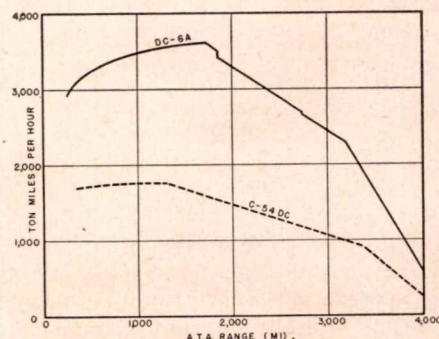
This data, however, is based on an "out-of-phase" relationship between the C-54 and the DC-6A. The C-54 has had ten years of development, while the DC-6A is just beginning its useful life; and, because of the many military C-54's manufactured, the purchase price of this aircraft is out of proportion with what an identical new airplane replacement would be.

Indications are that piston-engine aircraft will be the cheapest means of hauling air cargo for many years to come. It seems reasonable to expect a 20% increase in payload during the useful life span of the DC-6A. Such an increase would reduce the ton-mile cost to a figure 35% below that of the C-54. Similarly, because of its expected long life, the day will come when the initial capital investment will be written off and the DC-6A will show still-further-reduced operating costs. Under operating conditions comparable with those of the C-54, the DC-6A should be able to carry cargo for approximately one-half of today's costs.

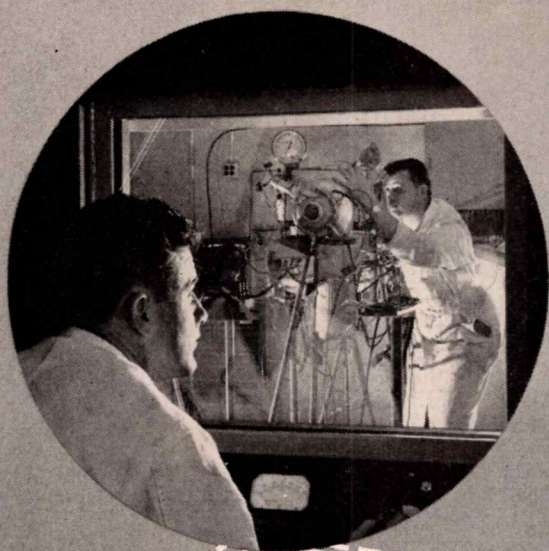
Passenger Facilities.—With its greater fuselage length, higher strength and greater payload-carrying ability, the DC-6A offers an ideal basic airplane for the high-density passenger field. One arrangement provides for 92 passengers plus a crew of four. This arrangement does not include coatrooms, relying instead on railway-coach and bus-type luggage racks. Galley facilities are not provided. Other versions include an 85-passenger transoceanic airplane, incorporating buffet, coatrooms and over-water equipment, plus a six-man crew.

The 92-passenger arrangement is convertible in 80-inch sections to

(Continued on page 122)

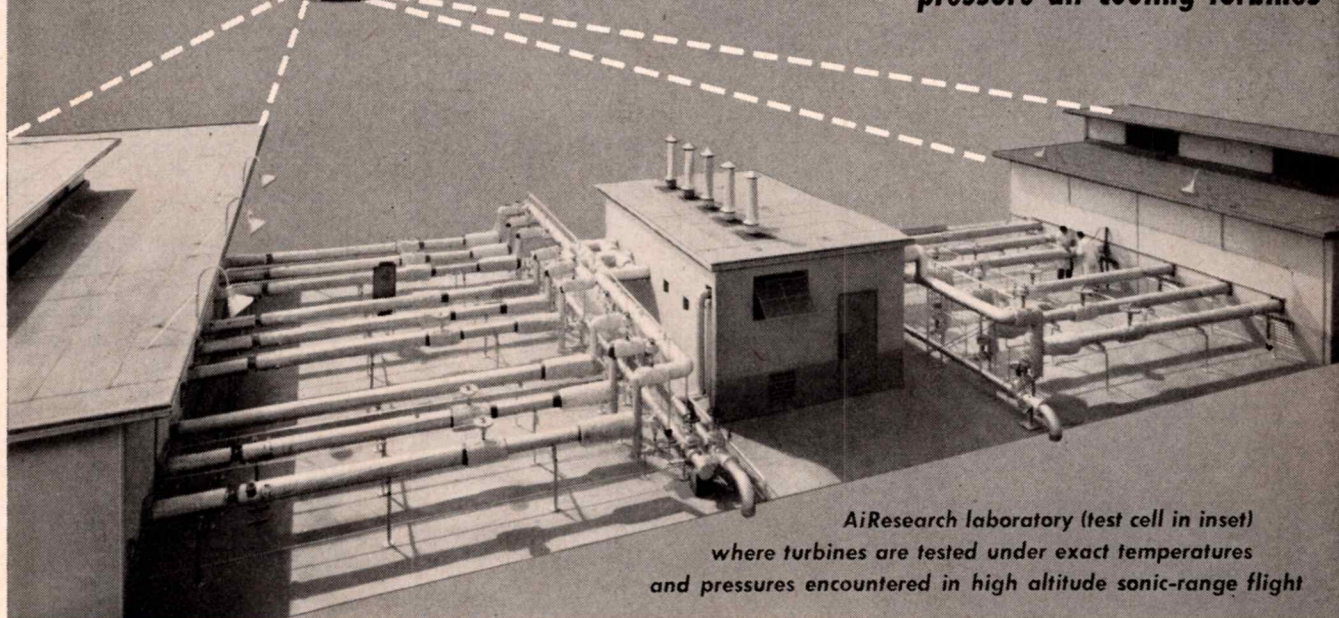


Reasons for lowered ton-mile cost of the DC-6A are shown above. DC-6A can carry more than twice as many ton-miles per hour as the C-54



NEW RESEARCH METHODS REVEALED

Unique AiResearch laboratory facilities simulate operations of jet engines for testing of high pressure air cooling turbines



AiResearch laboratory (test cell in inset) where turbines are tested under exact temperatures and pressures encountered in high altitude sonic-range flight

Flying at high altitudes and sonic-range speeds, jet planes generate terrific heat in their cabins. For pilot and crew comfort, AiResearch has developed high speed refrigeration turbines which convert high pressure, high temperature air bled from the jet engines into cool air to cool cabin interiors.

To deliver maximum efficiency, such turbines must operate in *exact ratio* to the pressure and volume of air bled off jet engines. Therefore, in order to test refrigeration turbines before installation, it was necessary for AiResearch to create a laboratory that simulates the actual operating conditions of jet engines.

This unusual laboratory produces exact air bleed-off conditions created by six of the newest type jet engines.

Here AiResearch compressors and furnaces manufacture compressed air from 100°F to 1000°F at 100 psi. Special control valves regulate temperature within 1°F and pressure within 2/10 in. Hg. This is another example of AiResearch's ability to exceed in the laboratory the most exacting and critical conditions of flight.

● **Whatever your field—AiResearch engineers invite your toughest problems involving high speed wheels. Specialized design and manufacturing experience is also available in creating compact turbines and compressors; actuators with high speed rotors; air, gas and fluid heat exchangers; air pressure, temperature and other automatic controls.**



►►► An inquiry on your company letterhead will receive prompt attention.
AiResearch Manufacturing Company
Los Angeles 45, California

IN THE HELICOPTER AFTER DARK

DR. ALEXANDER KLEMIN

Helicopter Editor

WE HAVE MADE a round-up of night-flying experiments and practice with Sikorsky Aircraft, Los Angeles Airways and the Helicopter Unit of BEAC—British European Airways Corp. It seems that a new field of opportunity has opened up for the helicopter, now that contact night flying and “round-the-clock” operations are possible. And night flying should be nothing more than a regular part of the helicopter pilot’s job and should cause him little concern if he exercises caution.

Sikorsky Night-Flying Tests

With Sikorsky S-51’s flying in dusk and dark on the Los Angeles Airways system, it is logical to begin our survey with Ralph Lightfoot’s report on it, *S-51 Night Flight Tests*. During the fall of 1947, the Sikorsky engineers and pilots made many flights and many changes in equipment. They finally

arrived at a satisfactory solution, and secured CAA certification for night flying. Here are the high sports:

- (1) In a helicopter installation the directional gyro is satisfactory. The gyro-horizon gives good indication of lateral trim, but is tricky in longitudinal pitch indication: “In level flight as determined by zero climb on the rate of climb indicator and constant altitude on the altimeter, the gyro would be set at zero. During a subsequent climb, the nose would drop and be so indicated by the gyro.” The gyro-horizon also showed contrariness under other conditions of flight. No wonder that they went back to calibrated scale of speed and inclination, and also power setting! Here is apparently something for the designers of gyro-horizons to think about
- (2) For night flying, paint the inside of the cabin and the under side of the main rotor blades a dull black.

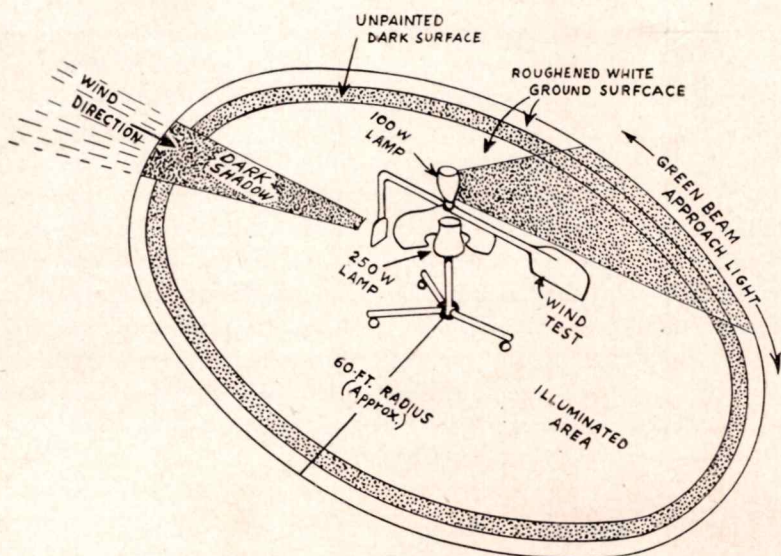
You will then have little reflection from the landing lights on your instrument panel

- (3) With a landing light placed at the nose of the ship, reflection from the runway caused such a glare that it was almost impossible to see through the plexiglas nose. Almost any position *aft* of the cabin is satisfactory, independently of the height of the light. Two landing lights, one on each main landing-gear strut, were the final solution.
- (4) The pilot should be able manually to control the landing lights individually—on and off, up and down—and to synchronize their up-and-down motion. The cut-off switch, which normally turns off the light as it nears complete retraction, should be removed
- (5) A 50-amp generator and 17-amp-hr battery are sufficient for two landing lights—provided the 22-amp heater is not in operation. But it is better to have a 75- or 100-amp generator and a 34-amp battery. (In aviation, don’t we always ask for bigger engines, motors, batteries?)
- (6) Every instrument on the panel needs powerful lighting. After many modifications, a specially notched, clear, Lucite panel over the instrument panel gave satisfactory instrument lighting.

Each pilot who flew the S-51 had a slightly different recommendation to make—they would not be true American pilots otherwise. But they all said that the Sikorsky S-51 is satisfactory in night flying.

The landing lights illuminate a sufficient area. The ground can be seen from 1500 ft, buildings from 1200 to 1300 ft, nearly everything from 1000 ft. and small objects from 300 ft.

On grass and light-colored surfaces, landings can be made with only the navigation lights. But over black surfaces, such as a macadam runway, it is hard to judge the last few feet of altitude and the amount of drift, and one or both landing lights must be used. Forward-speed landings have



For night landings, wind direction and illumination are supplied by the Wiggimac, in which the circumference of the illuminated area is marked by a band of white on the ground. Well-defined shadow of wind indicator indicates wind direction from a distance of 1000 ft



Sikorsky S-51 helicopter making a night landing using field floodlights. Landing light can be seen mounted on top of upper landing-gear strut

been made satisfactorily with the lights in various positions.

While hovering with both lights on, in the pull-up position, very good lighting is obtained on obstacles when the aircraft is yawed. However, regions directly beneath the aircraft are restricted. By adjusting the angle of the lights, the effect of flying the beam to the ground is attained, the visibility is good, and steep or shallow approaches can be made. Taxiing conditions are satisfactory using either one or both lights.

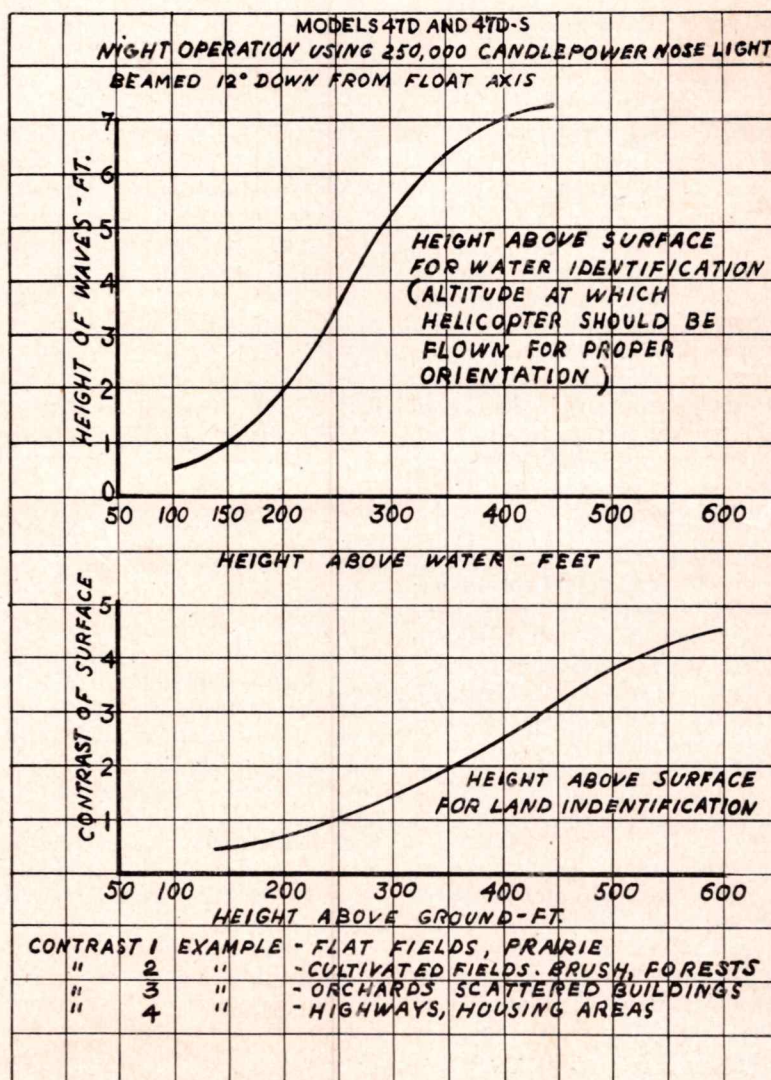
Bell Night-Flying Practice

Bell Aircraft has also secured night-flying certification and had excellent night-flying experience. In studying the practice of this company, we were lucky enough to receive an article published in *Rotor Breeze* written by Chief Test Pilot Owen Q. Niehaus.

Bell helicopters, certificated for night flying, are placarded to a minimum of 700-ft ceiling and 1-mile visibility. These minimums provide a satisfactory margin of safety when visual flight is conducted over well-lighted areas. But flying at some altitude, and with few ground lights, the pilot must be cautious, particularly when the helicopter is not equipped with instrument flying equipment. "Low-altitude flights (from the ground up to approximately 350 ft)" says Mr. Niehaus, "may on the other hand be conducted with the use of a landing light with little or no difficulty."

The following notes on experience and technique are based on the article by Mr. Niehaus and extracts from the Bell flight manuals.

(Continued on page 104)



Overland-flight altitudes should range from 300 to 500 ft depending on ground reference other than that provided by landing light. Over-water minimum altitude should be 100 ft, except under dead-calm conditions

Helicopter Legislation

THE NEW YORK STATE LEGISLATURE has recently revised its Rules of Flight and, in particular, has changed "safe altitude" to conform with Civil Air Regulations: "... a minimum of 1000 ft above the highest obstacle over congested areas and 500 ft above other areas, except over open water or sparsely populated areas, and in no event closer than 500 ft to any person, vessel, vehicle or structure."

But there is relief for the helicopter, we are happy to note that, effective July 1, 1949:

"Helicopters are permitted to be flown at less than the minimum prescribed altitude, if such operations are conducted without hazard to person or property on the surface and at an altitude which will permit an emergency landing without undue hazard."

Helicopter Exploits

IN ALL quarters of the globe, and in all manner of peaceful ways, the helicopter is adding to its list of useful and sometimes glorious achievements:

At the great Naval Air Test Center at Patuxent River, Md., Rear Admiral Apollo Soucek uses a Sikorsky HO3S-1 helicopter to inspect landscaping operations on the base. His helicopter test pilots fly over the base continuously, and the workers really work because they never know when the Admiral may be stepping out of one of the "whirligigs"!

- On the other side of the country, Helicopter Services of California has completed the dispersal of 1 million lbs of liquid chemicals to kill weeds in grain fields. This California concern has devised a complete spraying accessory system and specialized units for seeding and dusting, and custom-built 500-gal capacity tank trailers drawn by jeeps save time in bringing water for spraying operations.

- From California, let's turn to Africa, where the helicopter threatens the reign of the dreaded tsetse fly over more than 3 million square miles. To destroy the insect would clear great areas of the scourge of sleeping sickness, and save millions of dollars in meat losses a year. The tsetse cannot live without shade, so the Union of South Africa is clearing brush land to make sun-filled barriers. But the clever fly can attach itself to the shady

(Continued on page 123)



Courtesy San Francisco Chronicle

High Sierra

A GROUP was returning from a pack trip in Yosemite Park's Sierra Mountains. Suddenly one of the boys, Terence Hallinan, age 12, fell from his horse in the Benson Lake region (8100 ft above sea level) and was knocked unconscious. The area where the injured boy lay was surrounded by 10,000-ft peaks and a nearly-vertical ascent of 2000 ft would be necessary to get him out.

A doctor, rushed in by horseback in eleven hours from the nearest road, decided that the boy could not be moved unless it were by helicopter. A first attempt to make a rescue failed because of the rarified air and dis-

turbed terrain. In a second attempt, Pilot Deming flew a "Hiller 360" from White Wolf to Benson Lake, a distance of some twenty miles, in 36 minutes, took advantage of the still air of pre-dawn, carefully dodging mountain peaks, was able to land in a tiny meadow near Benson Lake, jettisoned a 37-lb battery and all his gasoline except that sufficient for the return trip, and brought the boy, carefully strapped in and conscious, back to safety in 22 minutes!

The San Francisco Chronicle used two full pages in bringing out the thrill and glory of this helicopter rescue. And so it should!

Helicopter Service For the New York Area

THE PORT OF NEW YORK AUTHORITY is fighting ably, with sound argument, for a helicopter service for the New York-New Jersey area. The Metropolitan area is broken into many segments by rivers and bays, transportation difficulties are great, traffic congestion is appalling and so are the distances from the airports to city centers. As a result, New York needs a helicopter service more than Los Angeles and Chicago, both of which it surpasses in size and population.

The Port Authority, which is responsible for airport development, is also interested in the development of helicopter sites within the Metropolitan area. It is now analyzing sites for heliports at the airports and on rooftops for its CAB exhibit in the New York City helicopter case.

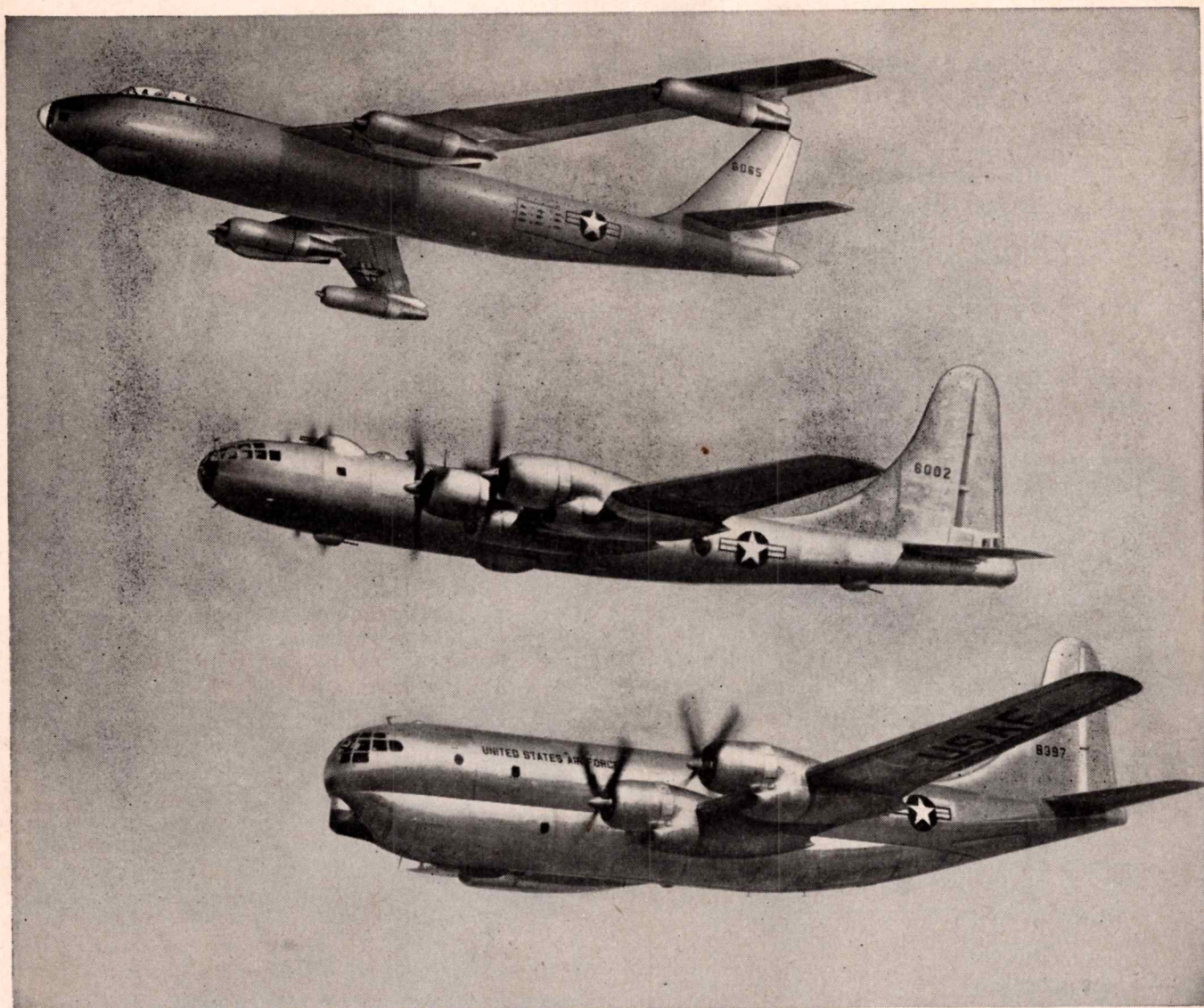
Its paper surveys have been under way for several months. On Novem-

ber 1, it operated actual flights over a 50-mile area in a Sikorsky helicopter piloted by Bob Dexter, chief test pilot of Sikorsky, and Boyd Kesselring, chief pilot of Los Angeles Airways. They included several simulated landings, and an actual landing at Newark Airport.

A discussion luncheon followed the survey flights. The conference brought together the leading figures of the helicopter industry. Frederick Glass, the Authority's director of airport development, introduced four distinguished speakers.

Clarence Belinn, president of Los Angeles Airways, made three excellent points: (1) LAA is not interested in the eight helicopter service applications for the New York area; all it desires is that the winning applicant shall be efficient; (2) the helicopter is a true flying machine and ultimately

(Continued on page 122)



In the front line of U.S. air defense

(1) The arrow-shaped Boeing B-47 Stratojet bomber, big as a B-29, faster than any bomber ever built! Designed to dart in at its objective with 10 tons of bombs, the Stratojet's blazing speed of over 600 miles an hour is its strongest defense.

(2) The powerful Boeing B-50 Superfortress, successor to the famed Boeing B-29. Last May, this 400-mile-an-hour strategic bomber circled the

earth on a non-stop, refueling flight, demonstrating that the U. S. air arm can reach any spot on the globe.

(3) The giant Boeing C-97 Stratofreighter, heavy-duty work horse of the Air Force. This twin-deck teammate of the B-50 can carry up to 26½ tons of freight — even tanks or heavy guns — or 143 fully equipped troops. In just three days on the Berlin airlift, this fast, powerful, efficient air cargo carrier,

carried 200 tons of vitally needed supplies into the blockaded German capital! The Stratofreighter is a sister ship of the new Stratocruiser now going into service on leading airlines.

Designed and built in co-operation with the U. S. Air Force, the Stratojet-Superfortress-Stratofreighter team plays a vital role in this nation's program to keep the peace of the world through airpower.

Built by Boeing for the U. S. Air Force are the new B-47 Stratojets, B-50 Superfortresses and C-97 Stratofreighters; for the U. S. Army, L-15 Scout liaison planes.

For the world's leading airlines, Boeing is building fleets of the new twin-deck Stratocruisers.

BOEING

WHAT'S UP... and WHAT'S GOING UP

Italian Executive Amphibian

Piaggio & Cia. of Genoa, Italy, has announced that its new P-136 5-place amphibian is ready for distribution. Powered by twin Franklin pushers with Hartzell variable-pitch props, it has a cruising speed of over 150 *mph* and lands at 70 *mph* with full flaps. Gross weight is 5500 *lbs*, of which 1750 *lbs* is useful load. Service ceiling is 16,700 *ft*, with a maximum range of almost 900 miles. Cantilever fuselage, gull wing and tapered nacelles give it sleek appearance.



Arctic "Neptune"

Equipped with 16-*ft* aluminum skis fitted over its wheels, the Navy's Lockheed P2V *Neptune* has become the largest plane to be equipped completely for arctic operation. It has been fitted with oversize heaters, a sun compass, anti-magnetic radio equipment, special cameras and winter-rescue gear. Skis retract into engine nacelles and wheels can protrude through openings in skis for normal landings.



New "Skyraider"

Douglas Aircraft announced an electronic version of their Navy attack bomber, the AD-3W. One of the most versatile military aircraft in production, the *Skyraider* is being manufactured in some 18 different versions and over 500 are already in operational service. Bulging shell on AD-3W is plastic radome, housing radar antenna.

"Super DC-3" Flies

Douglas took the initial *Super DC-3* on its first flight recently. After a brief testing-and-demonstration period—and certification by the CAA—it will be available with a choice of two engines, Pratt & Whitney or Wright. Gross weight is 29,500 *lbs*; cruising speed approximately 240 *mph*.

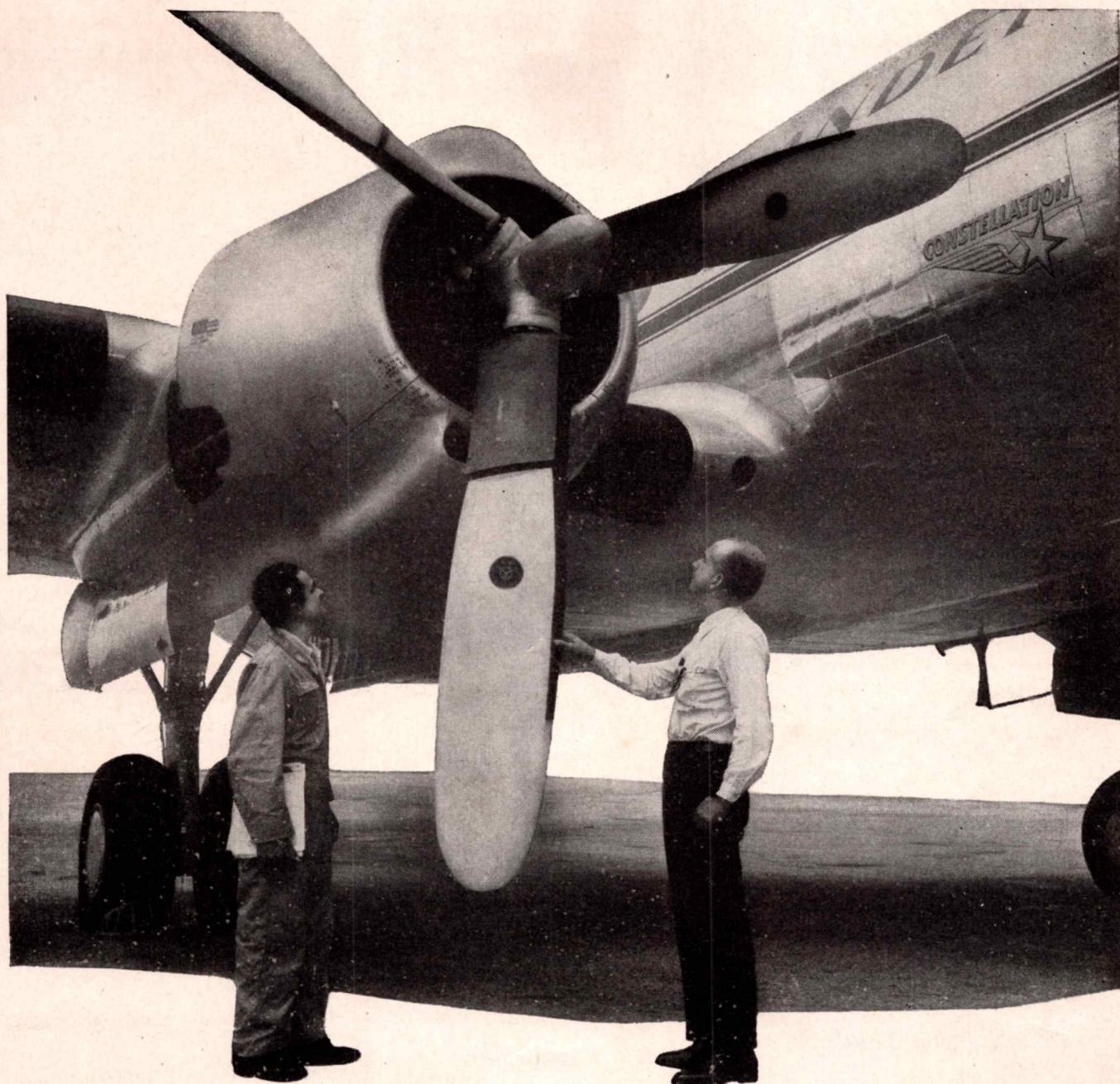
British Turboprop DC-3

Armstrong-Siddeley has converted a surplus Douglas C-47 to accommodate two AS *Mamba* 1475-hp turboprop engines. Increased power and lighter weight allows greater short-haul payload, and higher cruising speeds with little range penalty. *Mambas* currently are powering the Armstrong Whitworth *Apollo* and the Handley Page *Marathon* transports.

Briefs

BOAC has received first of 10 Boeing *Stratocruisers* for use in transatlantic service. . . . CAA has approved use of *Skytrol*, fire-resistant hydraulic fluid for *Super DC-3*, DC-4 and DC-6. . . . Owners of *Piper Clippers* report average cruising speed of 113.3 *mph* at 2390 *rpm* with fuel consumption at 6.13 *gph* in contrast with factory specs of 112 *mph* at 2450 *rpm* and 7 *gph*. . . . Piper also has completed tests on new *Hydrasorb* landing gear, which embodies a shock ring and an automotive hydraulic shock absorber. . . . Western Air Lines announces \$9.95 air-coach fare between Los Angeles and the San Francisco Bay Area; Western Union offices used as travel agents proving very successful, says WAL. . . . 24 Fairchild C-82 *Packets* have been assigned to the 60th Troop Carrier Group, USAF, in Germany. . . . AAL is equipping entire fleet of 74 Convair *Liners* with *Stratos* cabin superchargers. . . . Convair delivered first 20 L-13's to 7th Liaison Squadron, USAF, at March AFB, Calif., replacing L-5

Flying Jeep. L-13 is all-metal, with folding wings and powered by 245-hp Franklin. . . . MATS has taken delivery of first of 50 Boeing C-97A *Stratofreighters*. . . . Hamilton Standard is delivering new reversible 3-bladed *Hydromatic* propellers, designed specifically for the new, 107,000-lb Lockheed 749-A *Constellation*. They're also supplying 4-bladed reversible props for the Martin P4M-1 *Mercator*. . . . Chase Aircraft's XC-123 assault transport has completed first test flight; 500-*ft* takeoff run was made in 12 *sec* and landing roll was less than 6 *sec*. . . . Mrs. Mildred Zimmerman, 27-year-old Reading, Pa., housewife and former CPT instructor, broke the FAI international lightplane altitude record in a *Piper Cub* at 26,138 *ft*. . . . North American has developed all-weather version of *Sabre* jet fighter; F-86D has air intakes in fuselage sides and radar in nose. . . . Martin has testflown the XB-51, powered by three GE J-47's rated at 5200-lb thrust each. . . . B51 also equipped with parachute brake in tail.



New Curtiss Propeller

FOR THE NEW L-749A CONSTELLATIONS

A new Curtiss propeller has been approved by the CAA for unrestricted operation on Lockheed L-749 and L-749A Constellations. This propeller's high solidity provides improved take-off, climb and cruise speed at higher gross weights, and its rugged construction assures long service life.

Other service-proved Curtiss features incorporated in this new pro-

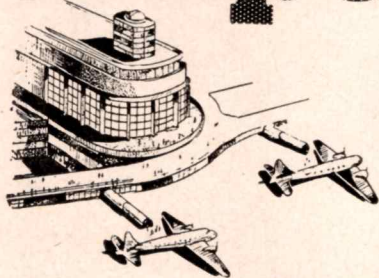
PELLER are . . . *reliable feathering* . . . *reverse thrust* for smooth, air-cushioned landings . . . *automatic synchronization* for passenger comfort and ease of control . . . *durable hollow-steel blades* for abrasion resistance.

The acceptance of this new propeller, after extensive stand and flight testing . . . under conditions surpassing the severest stresses of service use . . . is further evidence of Curtiss-Wright's leadership in the field of aircraft propellers.

CURTISS ***ELECTRIC PROPELLERS***
A PRODUCT OF
PROPELLER DIVISION CURTISS-WRIGHT CALDWELL, NEW JERSEY
FIRST IN FLIGHT



Airports and Airways



NASAO Officers

JAMES D. RAMSEY, director of the Nebraska State Aviation Dept., was elected president of the National Assn. of State Aviation Officials at the annual convention in New Orleans.

Crocker Snow, Massachusetts, was elected first vice-president; C. A. Moore, Mississippi, second vice-president; C. K. Faught, Wyoming, third vice-president; Claude B. Friday, New York, treasurer. New regional directors are: Richard Jamison, Maryland; Dexter Martin, South Carolina; Joseph McLaughlin, Illinois; A. W. Meadows, Texas; Norbert Locke, Iowa; Warren Carey, California; and W. M. Bartlett, Oregon.

Urge Film on Safety

A significant recommendation of the Airports Advisory Committee is in line with its conviction that the public should be made to understand aviation better.

It suggests that the story of the responsibilities and activities of the Civil Aeronautics Administration and the Weather Bureau be dramatized as an educational film by the motion picture industry, with particular emphasis on those activities which provide safety in aviation.

Birmingham Leads

THE Municipal Airport, Birmingham, Alabama, recently dedicated its new high-intensity runway lights. The units, 183,000 candle power each and set 200 ft apart, were installed on all runways.

It is claimed that Birmingham airport is now the only field in the country completely equipped with high-intensity runway lights.

Miami All-American Air Maneuvers

PLANs are well under way for the 1950 All-American Air Maneuvers to be held at Miami, Florida in January.

About 150 lightplane pilots will stage a mass flight to Havana on a cruise conducted by the Florida Air Pilots' Assn. They will leave Miami on Jan. 16, skirt the Florida Keys, meet at Key West and, after a final briefing, take off for Havana.

The Gulf-National Aerobatic Champion-

ship Contests, sponsored by Gulf Oil Corp. will be a feature. It will be run in one division, with men and women pilots competing on the same basis, and will be open to any type airplane and engine carrying a currently valid airworthiness certificate. Any pilot holding a currently valid CAA pilot's certificate is eligible.

In addition to the Gulf Trophy, the Gulf Corp. will award cash prizes totaling \$3500.

N. Y. State Disbursals

IN THE three-year period ending in 1949, more than \$16,000,000 of Federal and local funds will have been spent in New York State on airport construction under the seven-year program of the Federal Airport Act.

Twenty communities in the State now are participating in the program, which is designed chiefly for construction of new or expanded runways to accommodate heavier airline planes. The program includes improved runway lighting and terminal buildings. Broome County Airport and New York International Airport (Idlewild) lead the State under program expenditures.

Operators' Council

IN OCTOBER, officers and directors of the Airport Operators' Council met at Miami with airline officials to discuss mutual problems. Among subjects discussed were baggage handling, air-coach service requirements at terminals, freight-handling problems, loading-space priorities during heavy traffic hours, and future runway requirements.

The future runway length requirements may be from a maximum of 7000 to 8400 ft. A plan to install surveillance radar sets at 71 major airports was discussed. It was reported that one airline had ordered Super DC-3's equipped with caster landing gear.

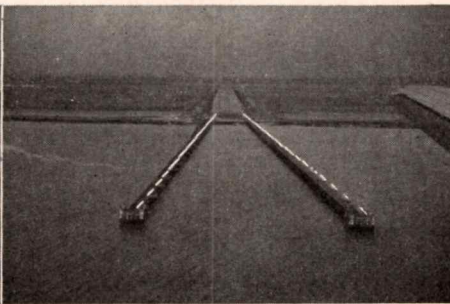
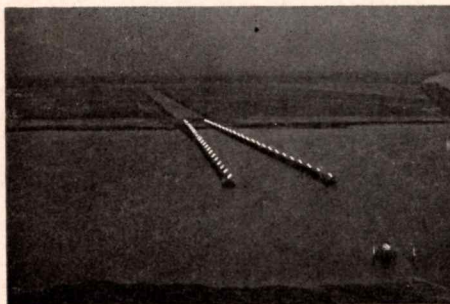
"Deal the Missus In"

IN A TALK before the Texas State Aviation Assn., George W. Jalonick, III, vice-president—sales, Southwest Airmotive Co., said:

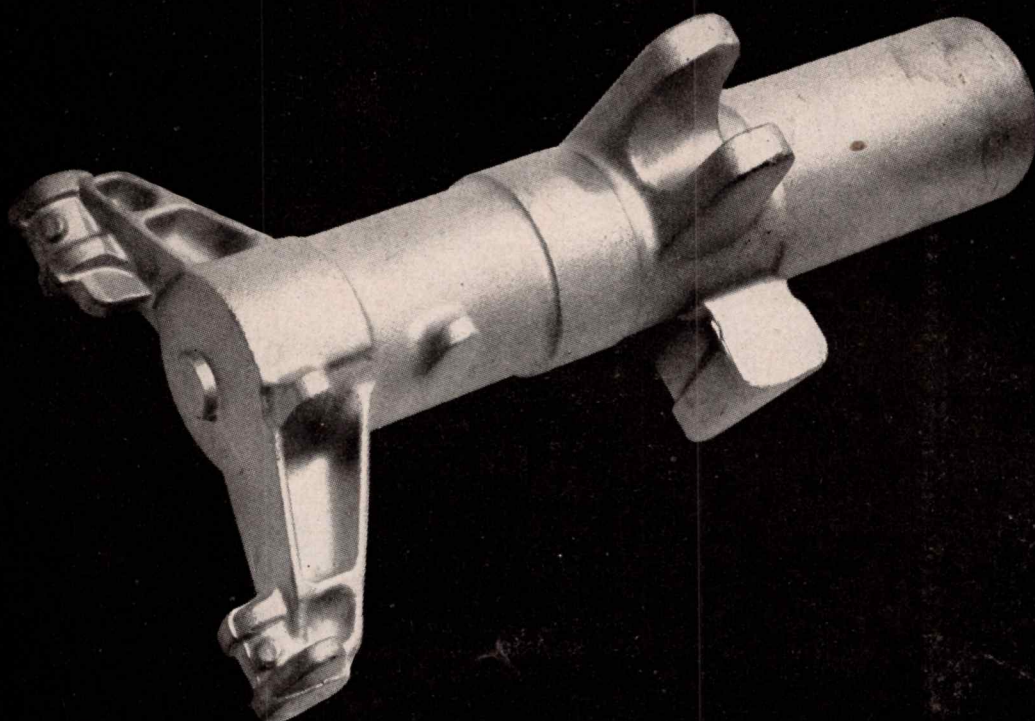
"An enterprising operator told me the other day that the wife is often the one who keeps papa from flying a private plane. Since that's undoubtedly true, our task is to sell the wife, too. Have you ever thought about making talks to women's clubs in town, having a Ladies Day at your airport, getting them to come out to the field for

their weekly social? Or, asking the local Garden Club to design or help you landscape your operations? It might be smart, too, to insist that the prospect bring the little lady along for that demonstration ride.

"This same operator makes it a point to find out when a prospect has an out-of-town business appointment. He then provides free round-trip transportation, and he urges that the Missus go along just for the heck of it. He's selling airplanes."



New slope-line approach system recently installed at N. Y. International Airport extends 2000 ft into Jamaica Bay from end of instrument runway. Light intensity can be varied by control-tower operator



Aircraft Landing Gear Forging—Weighing 275 pounds, this part is typical of the many large intricate forgings required on military and transport aircraft. Wyman-Gordon has specialized in aircraft forgings since the beginning of the aviation industry, and today produces the largest volume of the greatest variety of these important parts—forgings from five to one thousand pounds. And—there is no substitute for Wyman-Gordon experience.

Standard of the Industry for More Than Sixty Years

WYMAN - GORDON

Forgings of Aluminum, Magnesium, Steel

WORCESTER, MASSACHUSETTS, U. S. A.

HARVEY, ILLINOIS

- - -

DETROIT, MICHIGAN



This aerial-view map of nine of the 10 counties in the San Francisco Bay Area was part of the 123-page study of airport needs by the Bay Area Airport Planning Group. Main conclusion of the report was that present runway and storage facilities for private aircraft are so limited as to require immediate action. Navigation, traffic control and landing aids as well as improved ground transportation to airports were stressed. Two additional Class 1 airports were recommended for use in 1960

GOLDEN GATEWAY

KENNETH R. MacDONALD

Director, San Francisco Bay Area Chapter, National Aeronautic Association

SAN FRANCISCO, storied "City by the Golden Gate," with homes ranging like cliff-dwellings over 14 hills, is the pioneer metropolis of a 10-county Bay Area region, which boasts of remarkable records in all major phases of aviation.

Since the days of the windjammers, it has been a center for foreign and domestic trade as well as a financial, transportation and distribution center of world renown. Though still a great seaport, its residents admit that ships of the sea are slowly but surely giving way to ships of the air.

To the easterner, the San Francisco Bay Area means simply the City of San Francisco, as they know it. But to a westerner, the Bay Area is composed of San Francisco, Oakland, Berkeley, Napa, Burlingame and several other communities in the 10-county section with a total population of more than 2½ million. San Fran-

cisco, itself, occupies a narrow peninsula between bay and ocean and its citizens live and work in an area of but 45 square miles.

In the City of San Francisco alone, aviation has been shown to return more than 40 million dollars annual income to the community's residents and business firms. The 6000-employee, 22 million-dollar payroll of the 29 air carriers serving the Bay Area is greater than the 1944 "boom-year" payroll of San Francisco's entire water-transportation system.

Commercial Center

The commercial "core" of all aviation activity in the Bay Area is San Francisco's Domestic and International Airport in San Mateo County, on the southwest shore of San Francisco Bay. This 3722-acre air terminal is just off US Route 101, the Coast Highway; some 12 miles and 35 minutes

south of downtown San Francisco, and competes with Los Angeles and Seattle for top honors as the major gateway for transpacific air traffic.

The history of this undertaking goes back to November 2, 1926, when San Francisco voters amended the City Charter, authorizing the purchase of land outside the corporate city limits for the development of a municipal airport. The site, as originally selected, provided 160 acres immediately available for development; 1000 acres that could be reclaimed at low cost and additional areas of tidal flats suitable for reclamation and development.

The initial 1050 acres were purchased at a cost of 1½ million dollars and original construction involved two macadam runways, field lighting, a drainage system, four hangars and a temporary administration building. In spite of the fact that, upon completion,

only 20 privately owned aircraft were then based at the airport and commercial air transport involved only sporadic flights between San Francisco and Los Angeles, facilities were worse than limited. Private flying and flight instruction were then the major activities at the field.

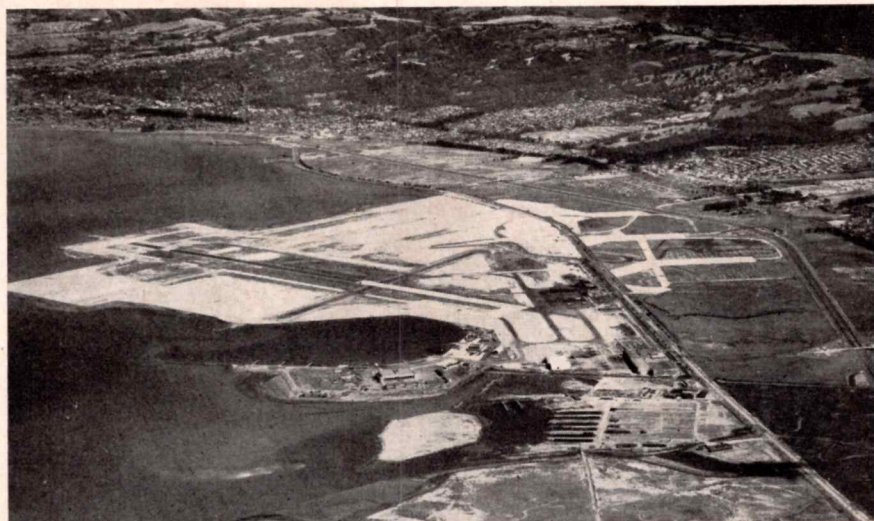
Six years following the birth of the project, the City Public Utilities Commission took jurisdiction over the airport and selected Standard Oil's dapper B. M. "Mike" Doolin as airport manager. "Mike" is still top man at the field, but with the current title of superintendent and chief engineer.

Pre-Doolin Expenditures

Prior to the time Doolin was appointed, the San Francisco Board of Supervisors had appropriated 1½ million dollars to finance, over a period of 10 years, the purchase of the original land area. In addition, another 1½ million dollars were spent in the reclamation of land and construction work. In later years, the Federal Government completed 12½ million dollars' worth of improvements at the airport.

Three airport bond issues have been approved by economy-minded San Franciscans, totalling over 23 million dollars, thus bringing the total taxpayer investment in the airport to a little over 26 million dollars, exclusive of the Federal investment. The availability of these funds made possible the development of airport facilities to sufficient size and capacity to focus the attention of the nation on the rapidly growing air-transport potential of San Francisco.

Development of these facilities eventually resulted in the transfer by United Air Lines, last year, of its main western operating base to the airport, as well as the erection of a Coast



Aerial view of San Francisco Domestic and International Airport, looking south toward San Mateo from San Francisco. US Route 101 to San Jose and Los Angeles can be seen at right; UAL maintenance base at lower right

Guard Air Station at the airport's amphibian base. Later, the main operating headquarters of the Pacific-Alaska Division of Pan American World Airways moved to the airport, as did the entire operating base of Southwest Airways, one of the most successful of the feeder lines.

At present, there are 13 major air carriers now operating out of this airport, as contrasted with three carriers serving San Francisco in 1941. In addition, there are innumerable non-scheduled, intrastate and charter carriers serving the city. Among the better-known scheduled airlines are American, TWA, Western, Philippine, British Commonwealth Pacific and China National, as well as Slick Airways and the Flying Tiger Line. In addition, many other carriers, including Air France, Braniff, BOAC, KLM, Northwest, SABENA and TACA, maintain

business offices in San Francisco.

The Civil Aeronautics Administration's Foreign Air Communications Station, which controls all transpacific aircraft movement, and Airways Traffic Control center are situated at the airport. Linked directly with ATC is a CAA-operated airport control tower, handling all traffic within a three-mile radius. One of the 15 ICAO-designated "main meteorological offices" in the nation also is based at the airport under the name of Airway Forecast Service—a 24-hour operation. Customs, immigration and public health offices are maintained at the International Terminal.

As this issue went to press, San Franciscans voted their approval of a new 10-million dollar bond issue to complete modernization of the airport. Officials believe that now the issue is approved, the airport will return a net gain of over 10 million dollars within 20 years. Had this vital issue failed to pass, they feared and expected that the port would be "in the red" by six million dollars exclusive of operating and maintenance costs, in the same period.

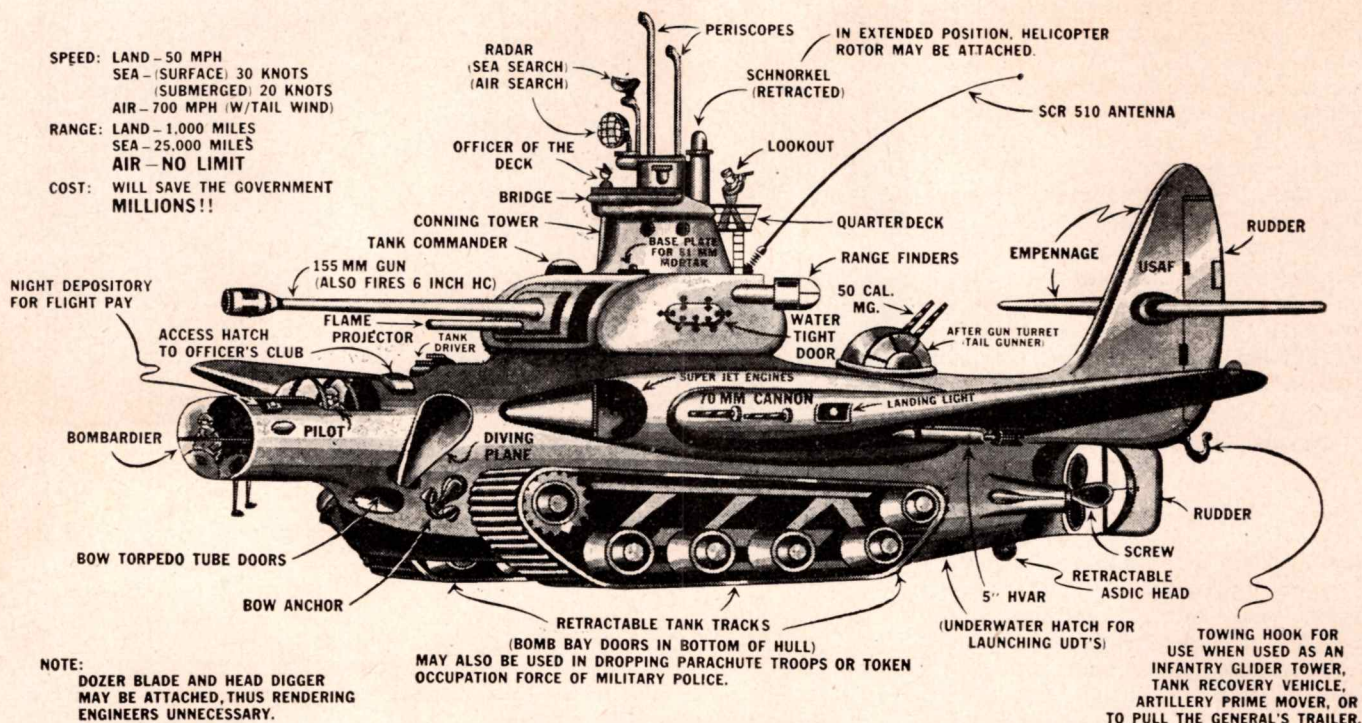
Anticipated Growth

Plans call for the development of facilities on a 10-year protraction basis, keeping the field that much in advance of expected traffic. The present domestic-passenger terminal, with 75,000 sq ft of floor space jammed to capacity, was designed to accommodate 3300 passengers daily. The projected 4½-million dollar terminal building is designed to accommodate 15,000 passengers each day. Present facilities are built five feet above sea level and will be at eight feet when

(Continued on page 80)



United Helicopter "Hiller 360's" lined up at Palo Alto Airport for the first mass commercial "flyaway" delivery in helicopter history. Approximately 92% of the aircraft is manufactured by Western sub-contractors, with final assembly handled by United's 130 employees at the Palo Alto plant, 32 miles south of San Francisco. United claims largest helicopter production



Military hybrid. Sketch of an all-purpose weapon, by an unidentified artist, which appears to contain all the elements necessary, and desirable, for any type of foreseeable warfare. Unification might well be a cinch through the employment of such a design pleasing everyone

STRATEGIC BOMBING and STRATEGIC THINKING

CY CALDWELL

THE most disturbing fact emerging from the testimony of the generals and the admirals who appeared before the House Armed Services Committee is that both sides seem to agree that the experience of World War II offers a sound basis for the evaluation of strategic bombing in the next war.

But was World War II a fair test? Let it be stated at once that World War II afforded no fair test of strategic bombing. It was employed mostly by the British and the American air forces, only to a limited extent in the opening months of the war by the Germans against England—not employed at all by the Japanese. Neither Germany nor Japan was able

to drop a single bomb on the U. S. That was a one-sided strategic-bombardment war.

The defensive failed for a variety of reasons—none of which may reappear in a war of counter-strategic bombardment between the U. S. and Soviet Russia. In Germany, the air defensive failed mainly because the 60 million outnumbered Germans, having omitted to win a quick victory over Great Britain and Russia, found themselves pitted against the industrial might and military power of some 400 million highly industrialized adversaries.

It is simply nonsense for 60 million people to challenge the world.

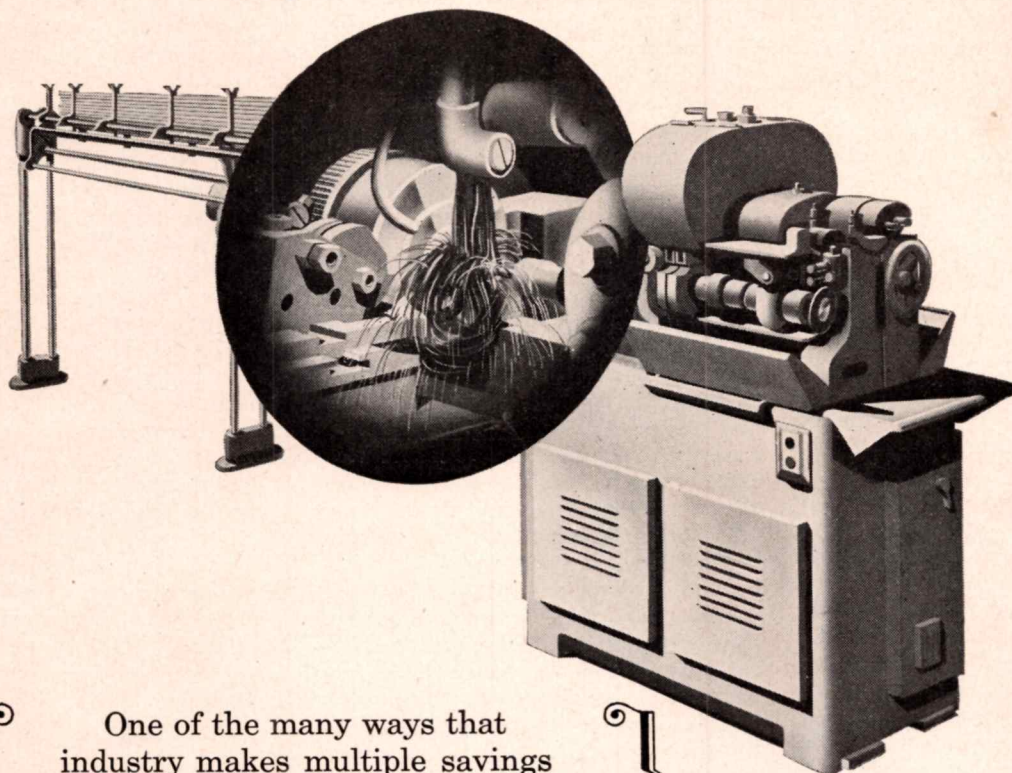
So far as Japan is concerned,

strategic bombardment had no test whatever—for the Japs did none of it, except in the one component of ship-based aviation, effective at Pearl Harbor, and the other component of quiet, ineffective, land-based bombers used against American naval forces—and ships at sea are targets only for tactical, not strategic, air forces. In knocking out the fighting potential of the Japanese air forces, the U. S. Navy's submarines accomplished perhaps as much as the combined air forces of the Army and the Navy, by sinking tankers. Towards the end of the war, the Japs ran out of gas; it was as simple as that.

In a war of counter-strategic bombardment between the U. S. and

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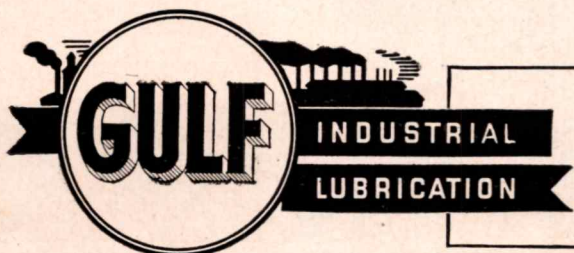
because of the exceptional cooling qualities of Gulf Cut-Aid we have no difficulty in holding tolerances to specifications."

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Great Britain on one hand, and the Soviet Union on the other, entirely different factors not only may, but must, be interpolated for study and evaluation. We should suppose that the Russians have studied these factors.

In his book *Global Missions*, General of the Air Force H. H. Arnold (retired) sets down this as his final and most impressive paragraph: "Russia has no fear of an army; she thinks hers is just as good as, and bigger than, any in the world; she has no fear of a navy, since she cannot see how it can be employed against her; but she does fear our long-range Strategic Air Force, which she cannot as yet match, or as yet understand. In the Strategic Air Force, coupled with our atomic bomb, at this writing we hold the balance of power in the world."

Soviet Thinking

Let us, for a few moments, try to do what no American normally does—endeavor to put himself in the other fellow's shoes. Let us try to think Russian, for if we are to fight Russians, we should try to find out what they may be thinking—and doing as the result of their thinking.

In the first place, they know from the evidence in bomb-blasted German cities that strategic bombing is a war force to be reckoned with seriously. They even may have concluded that this, rather than any other single factor, led to the eventual defeat of the Germans. And they must know that, with the use of the atomic bomb, the devastation will be a hundredfold greater. If they haven't got that far in their thinking they haven't got past World War I—an inconceivable assumption.

They know that in strategic bombing the Americans and the British have a start of one whole war ahead of them, for they themselves did none of it in the past war. They must start from scratch to build up a strategic air force. We must suppose that they have done so. That these bombers are capable of reaching America we should take for granted—else there is little use in building them, unless only England and western Europe are the proposed targets.

The Russians, we are told, now have the atomic bomb. Two whole years before our optimistic scientists expected it. We have lost some of our

complacency about THE BOMB. It was a great comfort to us. Our feeling about our possession of it was somewhat like our pre-war feeling about the Maginot Line and our mighty battleships.

We were shocked, momentarily by the announcement. Now we are complacent again. We have remembered that the Russians haven't our industrial know-how, or our resources. They can make the bomb—so what? Can they make hundreds? Thousands? Even if they have the bomb, have they anything comparable with our mighty B-36? Absolutely not! We haven't been to Russia recently—99 44/100% of us have never been there. We didn't go even when we were allowed in. But we *know* the Russians; Mr. White has told us all about them in his report.

Let us suppose, that the Russians have been concerned seriously about the possibilities of strategic bombing and atomic bombs, that they have the useful beginnings of a long-range strategic air force, a good start on the manufacture of A-bombs in quantity. Still, they must realize that, even with the best they have been able to accomplish with German scientific and engineering help, they are far behind the Americans and the British in the know-how of strategic bombing. Not a single pilot or bombardier in their air force received actual war experience in this long-range field, although large numbers have experience as attack bombers and as fighter pilots. In this category, their air crews equal the world's best, for what air power they employed in the last war was tactical aviation in support of their armies.

Is it not almost inevitable that the Russians, recognizing their inferiority in the field of strategic bombardment, must come to the conclusion that there probably will be a far greater number of forays against Russian

cities than they can send against American and English cities? In that event, they will concentrate their greatest efforts on the defense. Actually, no matter how many bombers we send against the Russians or they send against us, the only ones that will do any damage are those that reach their targets, against the opposition of defensive fighters.

There is a way of ascertaining, in advance of a war, some measure of how effective strategic bombardment may be. It is by staging a series of war maneuvers. The results may be evaluated by observers as to the number of interceptions accomplished, the numbers of bombers that got through to their objectives, the numbers that might have been shot down if live ammunition instead of camera guns had been used to register hits. Of course such tests are not conclusive. They fall short of war's reality. But not too far short to give at least a reasonable pattern of how men and equipment may be expected to perform in actual warfare.

We should assume that the Russians have been interested sufficiently in this vital matter to have staged many war games of their own. After all, if General Arnold is correct in his assumption that the Russians do "fear our Strategic Air Force, which they cannot as yet match or as yet understand," they must have done their best to find out something about it.

War Games

If the Russians have no bomber comparable with our best, they at least have many big bombers that probably can fly as high without a bomb load. They can approximate heights and speeds nearly enough to give a pretty fair picture of the best that can be sent against them. Or they can use their own jet fighters, simulating bombers, and ascertain if other fighters can manage interceptions.

Here are some of the questions to which the Russians probably have such answers as war games can give them. Can very large, heavy bombers penetrate the industrial heart of Russia against the opposition of much faster jets and piston-engine fighters? Can the bombers go it alone, relying only on their own defensive armament,

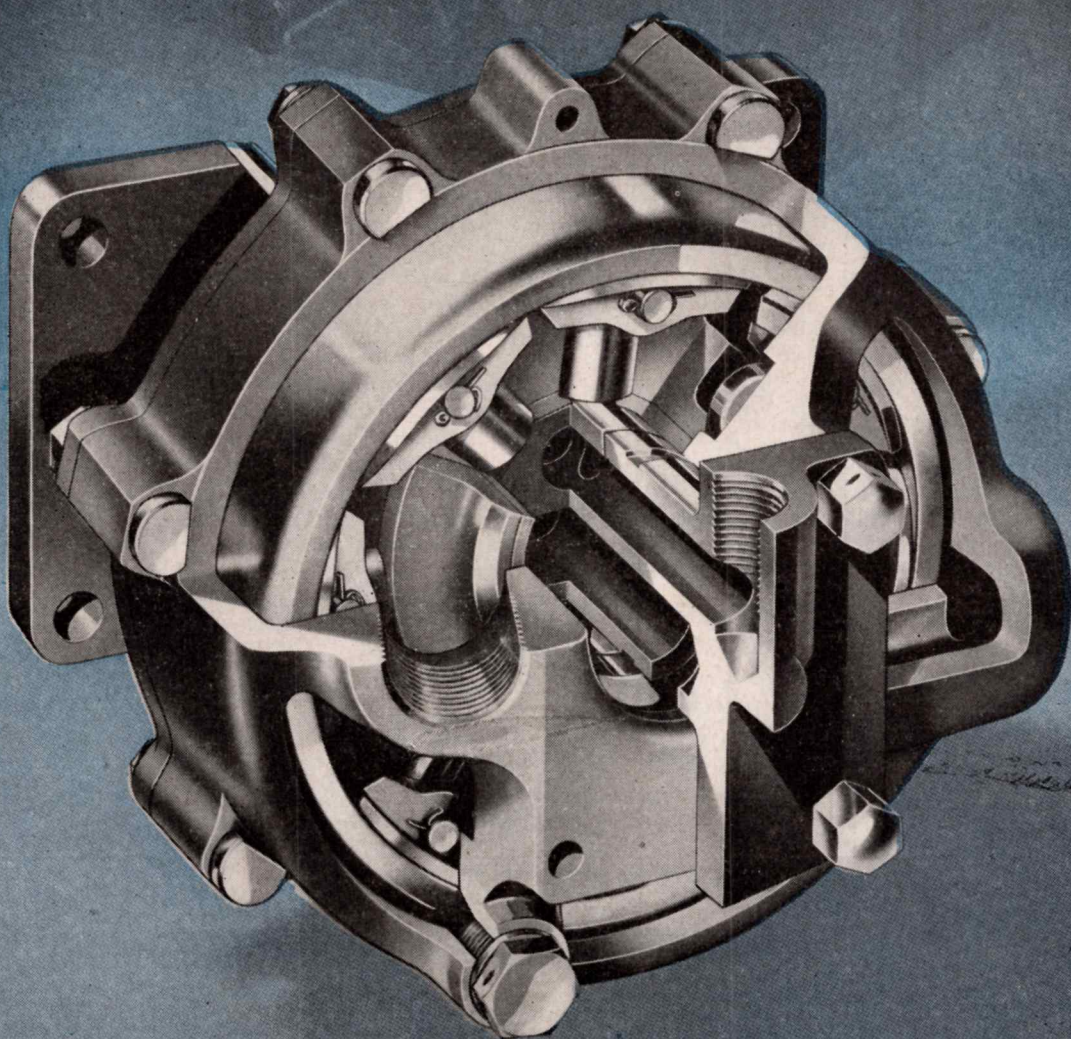
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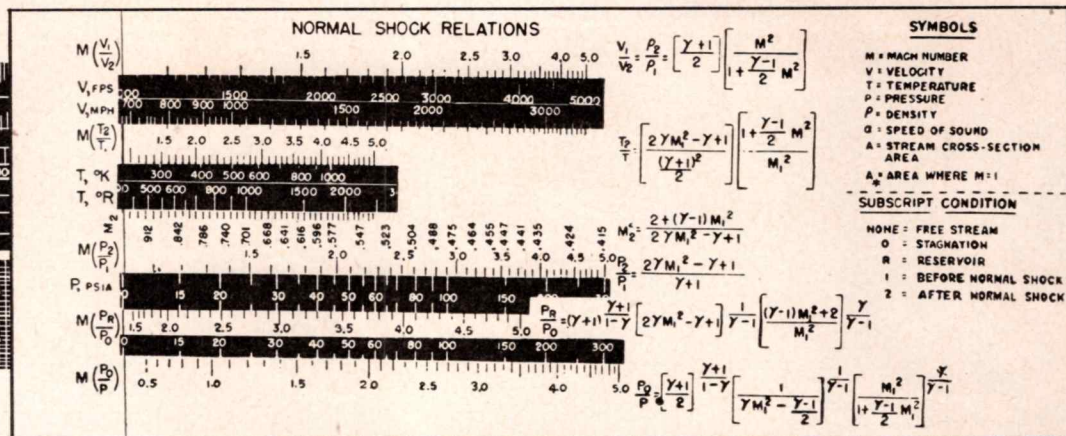
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Front

The AIRFLOW SLIDE RULE

LISBETH CROWELL

Research Engineer, Aeronautics Section, The Franklin Institute

NOW that transonic and supersonic flight are a reality, engineers, scientists, and laymen are becoming increasingly interested in the phenomena of supersonic air flow. Although these phenomena can be understood best by realizing the magnitude of changes which occur in high-speed flow, even the most elementary supersonic-airflow calculations involve laborious computation. The functions relating airflow properties appear to be so formidable that few people bother to make numerical calculations. Graphs and tables which show these functions are available, but even these require some mathematical calculations before absolute values can be obtained.

Some automatic means should be available for computing airflow functions rapidly in order that available data may be used with maximum ef-

ficiency and to maximum advantage. The Airflow Slide Rule, shown in fig. 1, was designed by the author to meet the need for such an automatic computing device. It affords an easy, accurate and rapid means of computing transonic and supersonic airflow relations.

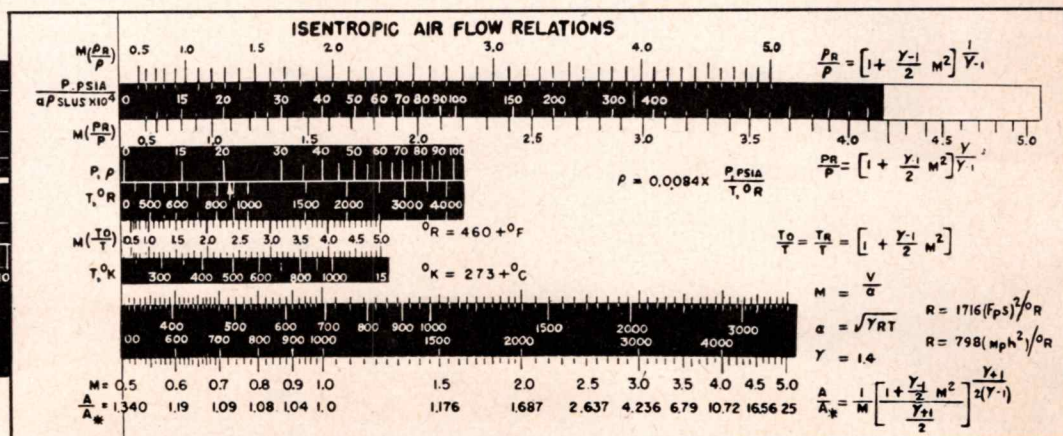
Two types of relations are involved in airflow calculations: general and specific. The general relations are limited to the physical properties of air. The specific relations define the changes in airflow characteristics when the flow is isentropic, such as the theoretical flow from a wind tunnel reservoir, and when supersonic flow is changed by a normal shock wave, such as would occur in front of any blunt body in a supersonic air stream.

The flow properties or characteristics most commonly used in calculations are temperature (T), velocity (V), pressure (P), density (ρ), and Mach number (M). Mach number—the ratio of the velocity of flow to the velocity of sound in that flow—is the parameter, or single variable used in all high-speed airflow theory for relating the flow property changes which occur in either isentropic or normal shock-wave flow. Consequently, these relations of flow property changes are often referred to as the Mach Number Functions.

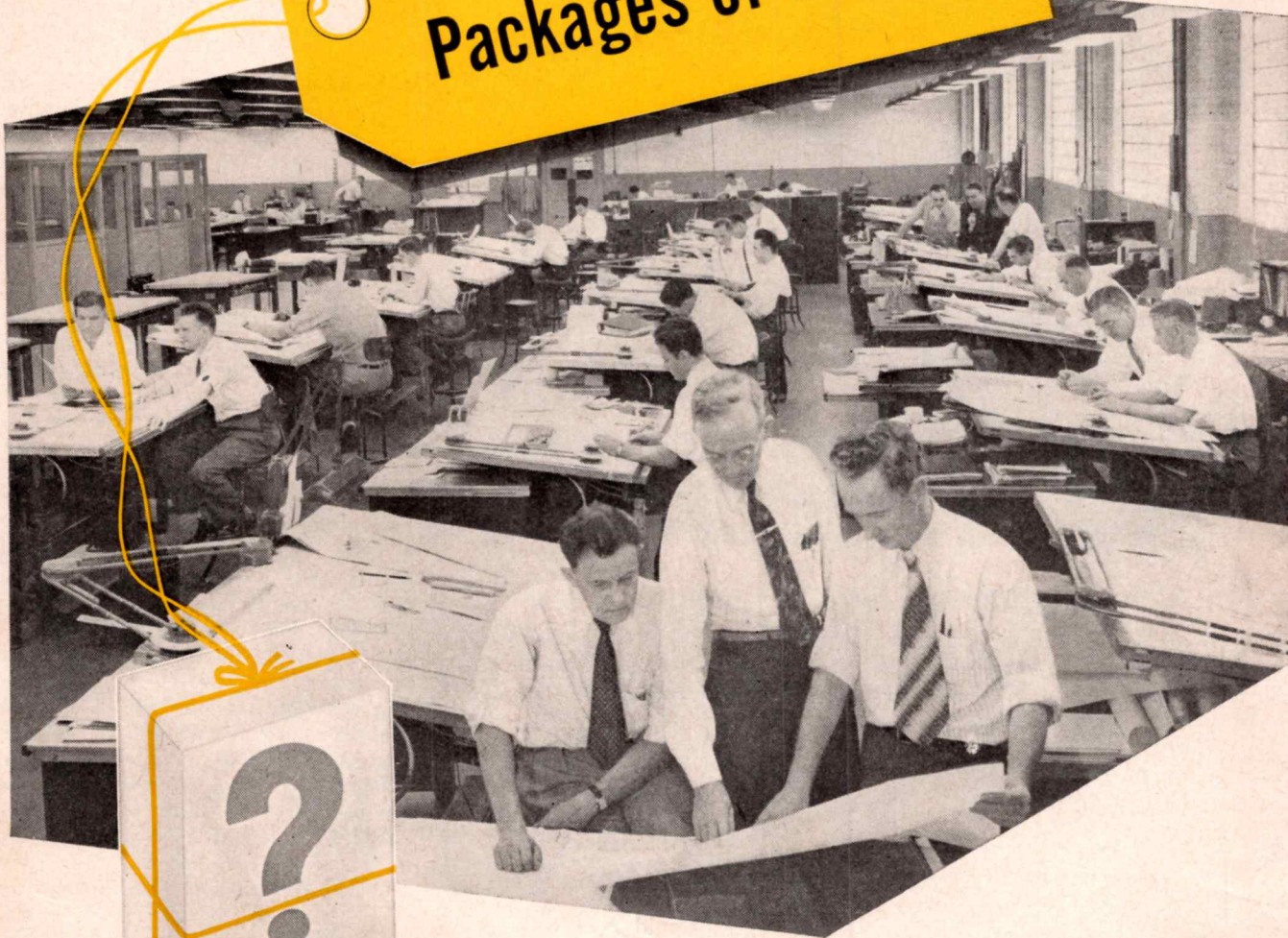
One face of the slide rule (fig. 1) is labeled "Isentropic Airflow Relations." This face is devoted to the general and isentropic functions. The reverse face shows the normal shock functions plus a pitot-static pressure relation calibrated for both subsonic ($0.5 < M < 1.0$) and supersonic ($1.0 < M < 5.0$) velocity flow. Each

(Continued on page 76)

Back



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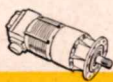
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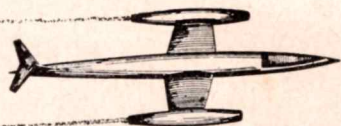
AIRCRAFT MOTORS



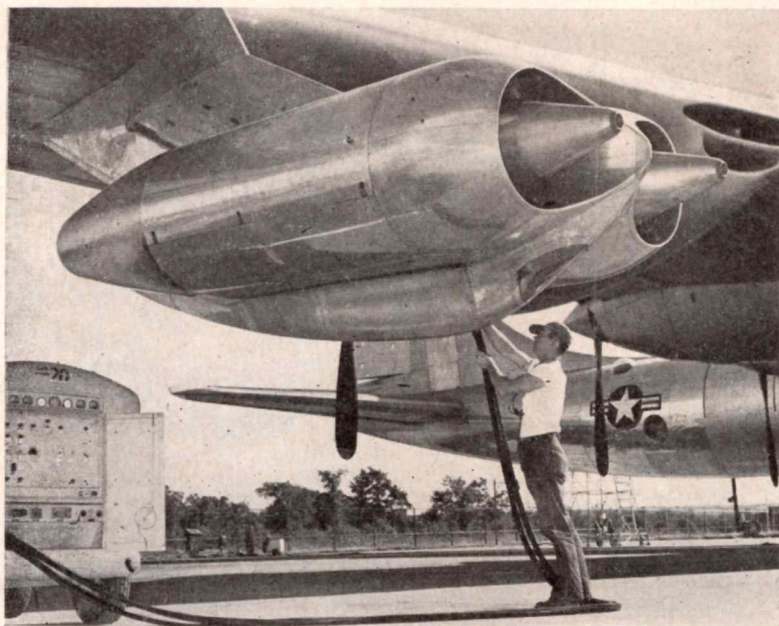
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REACTION-POWERED PLANES AND MISSILES



B-36 Receives Jet Augmentation

Photograph shows two of the four General Electric J47 turbojets installed on Consolidated Vultee's prototype B-36D now undergoing flight tests at Fort Worth. The four jets, mounted in pairs underneath each outer wing panel, add more than 20,000 lbs

of thrust to the 21,000 hp of the bomber's six 3500-hp Pratt & Whitney *Wasp Majors*—supplying extra power for takeoff and higher speeds within target areas. Jet "pods" are being added to every B-36; those delivered and those under contract.

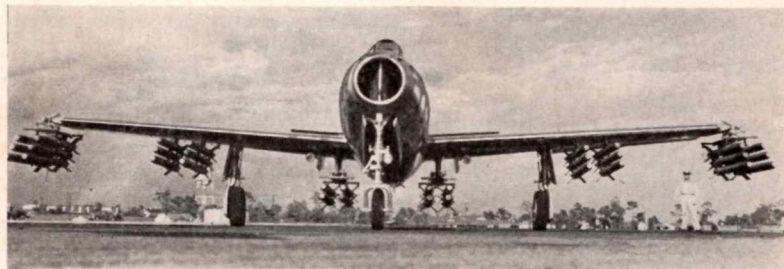
Oil Company Flies Experimental Jet

The Shell Oil Co. has installed a General Electric I-16 (J31) turbojet inside the fuselage of a B-26 type bomber equipped with two reciprocating engines and fitted with special analytical and recording instruments. The research plane is intended to supply detailed information on fuels and lubricants in both types of powerplants while in flight. Previously, research on jet engines had to be carried out in ground laboratories.

Instrumentation is such that a minimum of visual readings needs to be recorded in the air. Dials and gages on the instrument panel are photographed at regular intervals and a recording potentiometer puts other readings on a tape for transcribing and analysis after the plane is landed.

The air scoop for the turbojet is located on top of the fuselage and the tailpipe is led through the aft portion, as in fighter planes. The crew consists of a research engineer, pilot, me-

chanic and an instrument man. Direction of this research is by a six-man committee, headed by J. H. Doolittle, vice-president of Shell Oil Co.



Battle-Powered Thunderjet

The Republic F-84E is shown bristling with 32 five-inch, High-Velocity Aircraft Rockets. The plane can be converted also into a fighter-bomber or loaded with 12 HVAR rockets and two 1200-lb *Tiny Tim* rockets. Its fixed armament consists of six M-3

.50-cal machine guns. Flights have been made using a combination of rockets with addition of 230-gal wing-tip fuel tanks and JATO assistance for takeoff. High versatility is planned, including high speed and longer range.

(Continued on page 72)

"All-Weather" Jet

General Electric claims the distinction of having developed the country's first jet powerplant (the G E J47) capable of operating successfully under icing conditions. Heated air, supplied by the compressor, is applied internally to inlet guide vanes, fairings and forward frame struts. The hot air is said to prevent large accumulations of ice which can shut off the flow of air, or which might break off and enter the engine, causing critical damage.

An experimental model was used in anti-icing tests atop Mt. Washington last winter. The new devices later were put through flight tests on an engine slung underneath the fuselage of a B-29. The new features are to be incorporated in production engines as soon as possible.

Compressor and turbine improvements are said to have brought about an increase in thrust rating for the J47 without an increase in size or fuel consumption. Furthermore, reductions in the use of such scarce alloys as tungsten and cobalt increase the producibility of the engine without the danger of a production stoppage due to restricted world supplies. The J47 powers the North American F-86 and B-45, the Boeing B-47, Republic XF-91 and is installed in pods underneath each wing panel of the Convair B-36.

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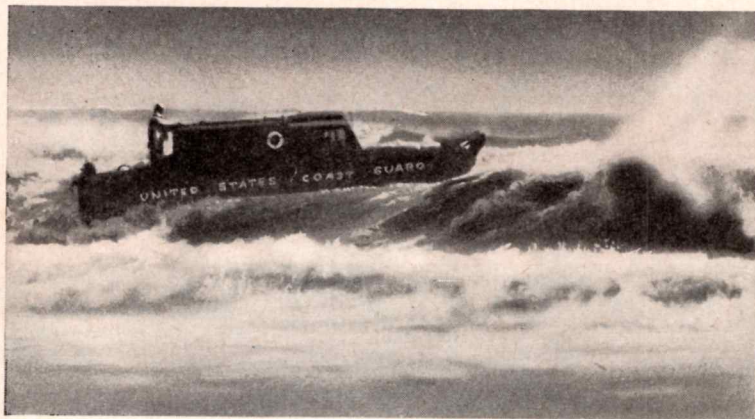
one more addition to the rapidly growing family of Westinghouse-powered airplanes for the United States military services.

J-50497

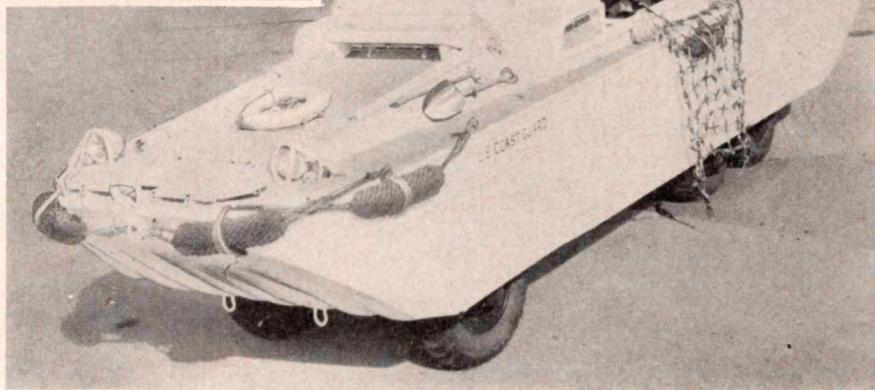


Westinghouse

**AVIATION
GAS TURBINES**



Coast Guard Air-Sea Rescue "duck" battling surf while putting out from shore on rescue mission in heavy seas



Duck should be painted white for easy visibility at night. Note life rafts, axo and ladder net for use in rescue operations. Crew normally consists of four or five men, all of whom have been trained in air-sea rescue techniques

AIRPORTS adjacent to large bodies of water are faced with the additional problem of off-shore rescue of survivors when an airplane overshoots the runway and lands in the water. The problem is particularly acute at night.

The most obvious answer is a crash boat with adequate crash-rescue equipment patrolling offshore or based near by. This is too expensive for most airports because it would require the cost of a boat, plus an adequately trained crew on three shifts.

This problem is emphasized by the fact that several such incidents have occurred off La Guardia Airport. Recently, a single-engined private airplane apparently overshot shortly after 10 A.M. A police launch was notified about one minute later, but it took 18 minutes to reach the scene of the crash. When a P-38 collided with an Eastern Airlines DC-4 off Washington National Airport, the pilot of the P-38 was rescued by a crash boat from Bolling Field. After a B-29 crashed off Kindley Field, Bermuda, the local Esso manager set out in a rowboat and rescued four crew members.

Every airport adjacent to a large body of water has this possibility to consider and a moral obligation to provide for it. Aircraft operators who serve the public as common carriers also must share the worry.

What should the airport management provide?

What should the air-transport operator provide?

(1) The transport operator should offer his passengers a ready and visible means of escape. This means the marking of emergency exits so they can be seen at night. (It would simplify the problem if aircraft were strong enough and watertight enough for the passengers to stay inside.)

PROBLEMS OF OFFSHORE RESCUE

JEROME LEDERER

Director, Flight Safety Foundation, Inc.

(2) Having provided the escape, he must offer his passengers a means for staying afloat. Life rafts and life vests are indicated, but there are numerous domestic air transports that take off from major airports where there would be little logic in requiring such equipment. Passengers will have to swim if they can and help others who cannot swim if they will. In cold water, the swimmers will have all they can do to survive without helping others. Rescue will have to be prompt.

(3) When an airplane ditches near an airport, rescue personnel presumably *will* be available and equipment *should* be available.

Most logical personnel will be the existing crash-fire rescue organization (unless a rescue boat is available and manned at all times).

Problem will be:

- (a) to find the survivors (difficult at night)
- (b) to rescue them.

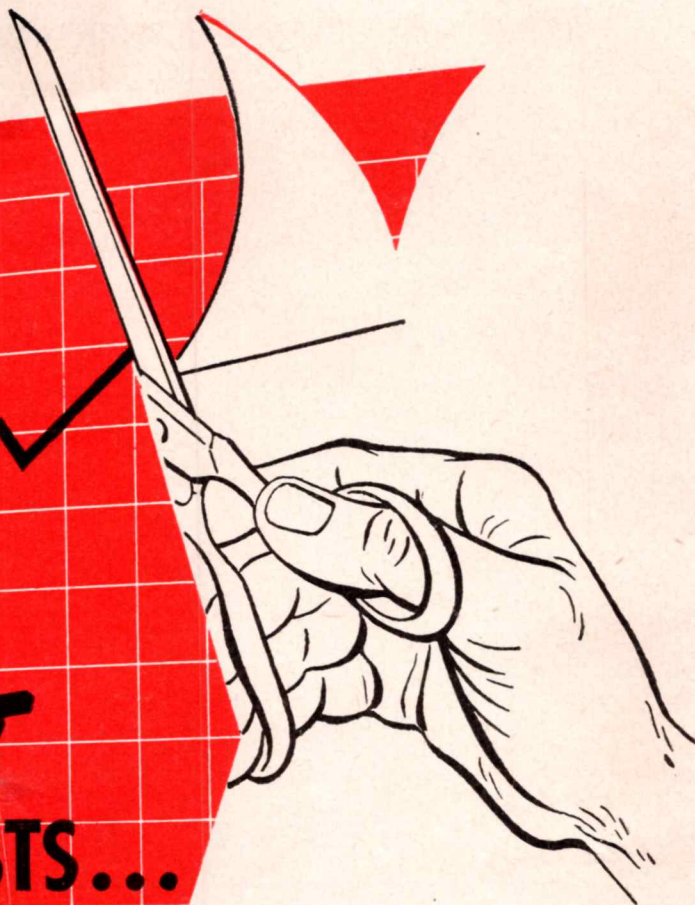
Assuming that few, if any, airports, can afford the luxury of a fully manned rescue boat operating on three shifts, the alternatives appear to be several boats fully equipped with rescue equipment located along the periphery of the airport available for operation upon instant notice. Rescue personnel would dash to the boats in automobiles, man them and proceed to rescue.

This has the drawback of requiring constant maintenance of equipment which is seldom used, with the possibility that, at a critical time, it would not operate because of some oversight in maintenance. Maintenance of a boat is likely to be troublesome and expensive. Sailors know that it is easier to maintain a boat in operation than one that is idle. Nevertheless, if this idea is practical it should not be discounted.

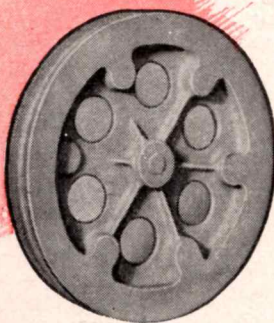
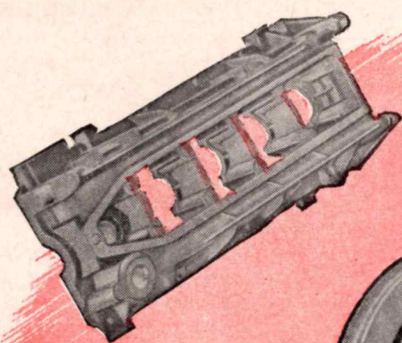
The other alternative is the use of an amphibious "jeep" or so-called
(Continued on page 103)

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PERSONAL AIRCRAFT DEVELOPMENT

(Continued from page 20)

without having to start and finish his trip with the help of some other vehicle, at a considerable cost in both time and money.

Developments in the helicopter field and the machine's advantages and disadvantages are too well-known to require extended discussion here. Suffice it to say that rotorcraft, though readily available from several manufacturers, have not invaded the private market to any measurable extent. Obviously, further improvements are necessary.

Details of several airplanes designed to operate from areas only a fraction the size of even the smallest airports, have been studied by the committee. Perhaps the best known of these is the *Helioplane*. This airplane embodies a geared engine, very large propeller, automatic slots, full-span flaps, spoilers, and mechanical devices which ensure adequate aerodynamic control at air speeds below 30 mph. While none of the visible modifications are new, the combination results in landing and take off performance not before approached with comparably low hp.

Other similar developments, known only through information supplied by their builders, are the Lanier *Paraplane* and the Jamieson *Jupiter*. The former claims speeds ranging from 25 to 110 mph on 90 hp, made possible by a "Vacujet" airfoil, which is

described as a "combination flap, air chamber-air brake and boundary layer control." The latter expects a speed range of from "under 40 to 150 mph" with 115 hp.

Plans have been made to produce and market versions of all three. While this approach to the problem, when accomplished, undoubtedly will provide a private conveyance with much greater utility than the best presently available, it still is subject to the drawback that a ground run is required for both landing and takeoff. This means that even a small prepared landing area is necessary, because ditches, hidden obstructions, sand, mud and snow would be almost as harmful to the complete success of a slow landing as a fast one, and a complex combination gear still will be needed for amphibious operations.

Few aeronautical scientists doubt that an aircraft embodying the advantages of the present airplane can be designed to hover in still air and to land and take off at zero forward speed. This attribute, combined with required factors of speed, cost, comfort, and safety, would remove the major deterrents which now exist to the extensive use of personal aircraft. Real utility would be created by a true "omnibion," capable of landing on and taking off from any type of surface large enough only to accommodate

its alighting gear and shape; safety would be enhanced by the ability to come to a stop in the air; and bad-weather operation would be tremendously simplified by the practicability of vertical ascents and descents guided by a simple radio device like a VHF Z-marker.

Developments along this line fall into two general classes: devices to create air-flow and lift over stationary airfoils, and "converta-planes" that use rotating airfoils set vertically to provide lift and set horizontally to provide thrust for conventional wings.

Work in this category is still mostly on the drawing boards. Only two specific projects are known to the committee, the Custer *Channel Wing*, and the hermaprodite of the Transcendental Aircraft Corp. There is doubt whether either will be carried beyond the experimental stage in its present form. The Custer is designed to obtain direct lift by passing propeller-motivated air through cylindrical wings.

The other concern is working on ideas presented by Barnaby, Berkowitz and Colcord in a paper entitled, *Convertible Aircraft*, published by the IAS. Simply stated, take off and landing will be by helicopter, and flight will be by airplane, using the same mechanism for both direct-lift and thrust.

Another interesting approach is that of the roadable airplane. It will be remembered that Convair, shortly after the war, built and flew a flying automobile; but the project was later abandoned. The Fulton *Airphibian* seems to be the current development in this field most likely to reach the market in the near future. Two-place and 150-hp Franklin-powered, it is said to have flight performance similar to a fully loaded Stinson *Voyager* and normal performance on the road. Small-scale production is planned for the near future with an expected sales price of under \$10,000.

Similarly, the *Aerocar*, not yet flown in early October when our data was received, uses a 100-hp Franklin to "wed an Ercoupe to a Crosley."

Aircraft of this sort will use conventional existing airports; their wings and empennage must be detached and left behind when they are used on the road. This presents the obvious drawback that, when on wheels, one must return to the airport the last landing was made before flying again, a condition which will not prevail when wings can be folded or retracted and carried along on the highway.

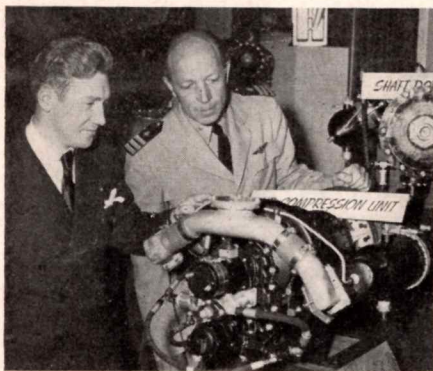
It is interesting to pause and compare the potential attributes of the ultimate self-contained roadable airplane and the zero-speed craft. The former will not, *per se*, be any safer or more capable of being used in the air in bad weather than the present airplane, nor will it be able to take its passengers to places now inaccessible by airplane or automobile. Still, the ability to travel on the surface when the weather is bad and to reach the many places connected with airports by roads would be a great improvement.

Conversely, the latter probably could not be flown in quantities to a metropolitan shopping, theater or hotel area and parked, because of traffic and congestion—a problem which also plagues the common automobile

(Continued on page 82)

REACTION-POWERED PLANES

(Continued from page 68)



a 25% power increase over the XB-47, powered by J35 engines, which made a record transcontinental flight last January at an average speed of 607.8 mph. The J35's produce 4000 lbs of thrust apiece. Actually the new *Stratojet* has a power potential of 49,200 lbs of thrust, by combining the output of its six engines and JATO units.

Both of the Boeing XB-47's built at Seattle, are now based at Wichita where the new B-47A bomber is in production for the Air Force.

Auxiliary Gas Turbines

AiResearch Manufacturing Co., Los Angeles, displayed an auxiliary gas turbine at the recent SAE Aeronautical Meeting on the West Coast. The turbine shown weighs 88 lbs and is said to develop 65 hp in the air. It was designed for the operation of all aircraft accessories.

More Powerful Stratojet

Boeing announced the first flight of its XB-47 medium bomber equipped with six General Electric J47 turbojets, developing 5200 lbs of thrust apiece and said to be the most powerful jets in production in the U. S. Thus the bomber will have better than

Jet Briefs

Wright Aeronautical Corp. announces that construction is progressing on a \$600,000 ramjet laboratory for testing supersonic engines at its plant. It is being built near the company's gas-turbine laboratory and will share the latter's power source. . . . Humphrey W. Toomey, manager of Pan American World Airway's Latin American Division, believes that jet airliners soon will be flying the 1166 miles between Miami and Panama—in about two hours. . . . The Metal Products Division of Ryan Aeronautical is producing transition liners, inner and outer exhaust cones and inner combustion chambers for the G E J47.

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advantages

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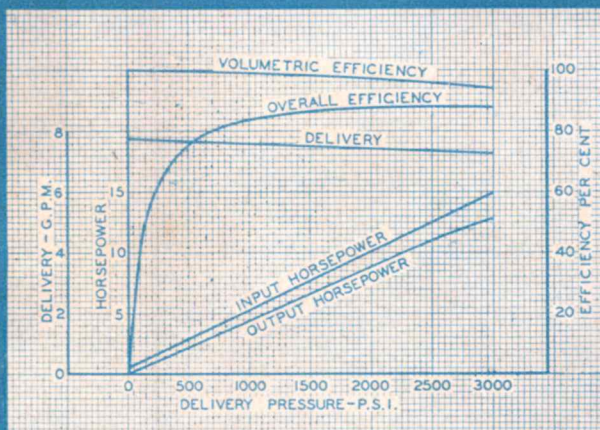
SIZES TO
40 hp

PRESSURES
to 3000 psi

Listed at the left are the important reasons why Vickers Constant Displacement Piston Type Pumps are so widely preferred for modern aircraft hydraulic circuits.

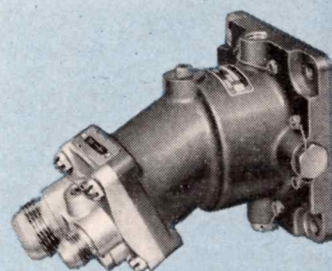
Note particularly the typical performance curves that prove the very high volumetric and over-all efficiency of these pumps. Extremely high horsepower to weight ratio is also important . . . 1.96 hp per lb for the Model PF-3911 Pump operating at 3000 psi and 3750 rpm. Dependability is another feature . . . airline life in excess of 10,000 hours has been reported. Each of the six basic model series shown here is available in four sizes (angles) for continuous duty at pressures to 3000 psi.

Ask for new Bulletin 49-53 describing "The Most Complete Line of Hydraulic Equipment for Aircraft."

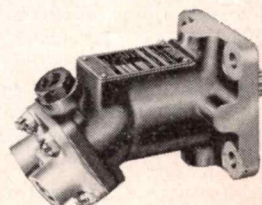


Curves are for Vickers Aircraft Piston Type Constant Displacement Pumps Model PF-3911 Series at 3600 rpm using approved AN aircraft type hydraulic fluid.

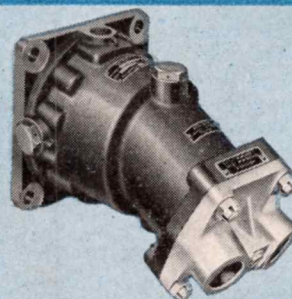
Vickers Model
PF-3911 Series
for 3000 psi



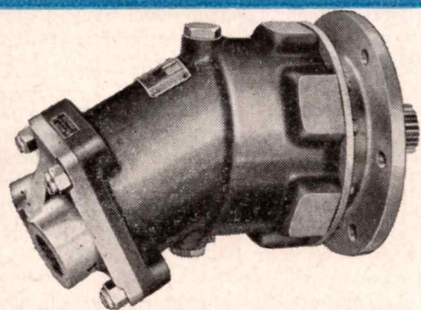
Vickers Model
PF-3906 Series
for 3000 psi



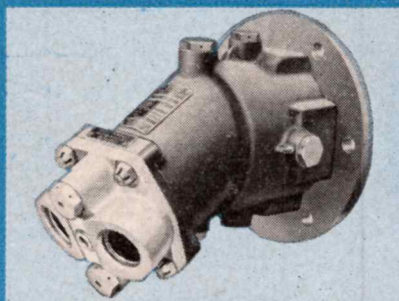
Vickers Model
PF-3913 Series
for 3000 psi



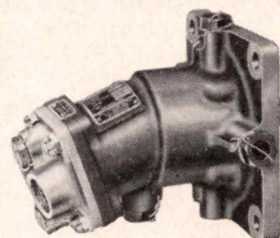
Vickers Model PF-3918 Series
for 3000 psi



Vickers Model PF-3915 Series
for 3000 psi



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SAND AND DUST

(Continued from page 47)

schedule that is followed from start to takeoff and climb, and from approach to landing and shut down. The dust weight-flow per unit of time that would be ingested at each of the power conditions was calculated, using the corresponding engine mass airflow at sea-level conditions. An average time that an aircraft normally remains at each of the power conditions was arrived at by timing many flights from Wright Field.

With the time periods for each power condition calculated, the total weight of sand that the engine would ingest for that period was obtained. The conditions used in each run were as follows:

Engine Condition	Time	Total Sand
Idle	1 minute	336 grams
Taxi—60% rpm	4 minutes	3240 grams
Takeoff—100% rpm	1 minute	1620 grams
Approach—Land— Taxi 60% rpm	4 minutes	3240 grams

The sand and dust were introduced after each power condition was reached and stabilized. This schedule was to be followed until engine failure requiring removal occurred, or a sufficient number of takeoffs and landings were accomplished to correspond with the normal overhaul period of the engine. For the F-84 aircraft, assuming fuel endurance of three hours per flight, and a 150-hour engine overhaul, this would amount to 50 takeoffs and landings. Periodic inspections were made of the progress of erosion by removal of the engine from the aircraft and partial disassembly of the engine.

Regular Equipment

Only the standard cockpit instruments were used for engine rpm, tailpipe temperature and fuel and oil pressures. In any further testing, a bearing air-pressure line will be instrumented to indicate the extent of clogging of the air filter in the line, to avoid engine-bearing failures.

The engine used was subjected to standard calibration prior to the dust tests to provide a basis for measurement of performance deterioration.

The schedule was followed for four runs at which time the engine was removed, partially disassembled and inspected. All internal surfaces exposed to airflow were quite clean, including the spark-plug electrodes—giving rise to possible use of small quantities (1 or 2 lbs) of dust for periodic cleaning of the engine. Very minor erosion was observed and the engine was reinstalled and the schedule continued with visual inspection only until 15 runs were completed.

A hydraulic leak occurred, necessitating engine removal at this point and again the engine was partially disassembled and inspected. The progress of erosion was observed but no serious wear was apparent. The engine was reinstalled and the schedule was continued until 26 runs were completed. At this point, bearing failure occurred and the engine was removed, completely disassembled and inspected.

The bearing air filters were clogged severely with sand and dust. (fig. 4) The cause of the bearing failure was not clearly

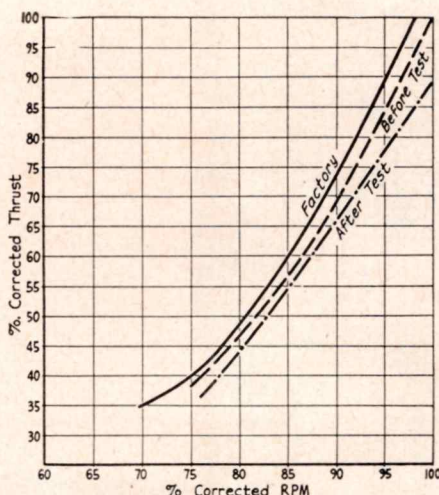


Figure 5

the result of the clogged filters, in that all filters were clogged and the remaining bearings gave no indication of impending failure. Airflow checks on the clogged filters indicated that a considerable flow of air was obtainable still. However, No. 2 bearing was the most critical and the reduced airflow probably accelerated failure.

Erosion was apparent in all stages of the compressor and on the leading edges of the midframe islands. The starter-generator unit contained a considerable quantity of sand and dust, and the commutator and brushes were eroded and pitted. The compressor lands showed some pitting on the top half. Certain portions of the aircraft duct walls showed mild erosion; all other engine components showed little or no erosion. The static and dynamic balance of the compressor and motor was not seriously affected.

Vibration readings during the calibration run after the test improved over the first calibration of the engine. Characteristic deposits of the fine dust were found on all surfaces, including compressor rotor and turbine blading, indicative of airflow conditions at those surfaces. This suggests an experimental technique similar to the use of strains for qualitative checks on internal-airflow conditions in a turbine.

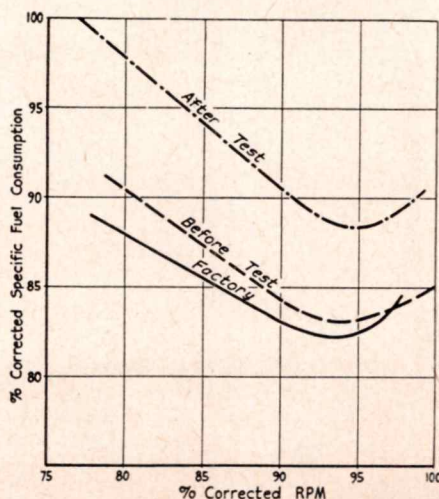


Figure 6

At the completion of the 26 runs, a total of approximately 474.5 lbs of sand and dust had been passed through the engine. On the basis of 3 hours per flight, this would be equivalent to 78 hours engine time. The effect upon thrust and specific fuel consumption indicated by a calibration run is illustrated in figs. 5 and 6 as compared with the factory calibration run and a calibration prior to the dust test. Continuation of the J35 tests by AMC is planned in an effort to determine extreme limits of operation under sand and dust conditions.

Comparisons of results indicate that an accelerated test, using high sand concentrations in a short period of time, is not a valid test, in that erosion is much more rapid and severe for equivalent total quantities of sand and dust than when conditions approaching natural are used.

The conditions of the test were conservative in that the dust conditions existed for every simulated takeoff and landing of the aircraft during the total test, which may not be the case in actual operations; the sand and dust had a uniformly high abrasive quality; natural conditions will vary considerably; a separation effect may be exercised on the larger, more-abrasive particles by airframe air inlets of another type than the test inlet; sand and dust concentrations will be lower where engines are mounted high in the nacelles or wings.

On the other hand, the conditions of the test were not conservative in that ground engine operation periods in sand and dust may be considerably longer under certain tactical conditions than those of the test; flight time and sand dust may be considerably longer in regions of frequent dust storms where concentrations of dust reach altitudes up to 8,000 and 10,000 ft: the force exerted on the ground by jet wakes in mass operations may produce concentrations of sand and dust greater than that used in the test which was based on measurement behind propellers.

Allowances

Results must be considered in relation to engine time in flight, compared with that on the ground, varying considerably between types of aircraft missions.

The data indicate that while aircraft gas turbines may not be rapidly or grossly affected they are not immune to sand and dust problems and present a situation worthy of further consideration. Any protective measure attempting to remove sand and dust from the intake air appears hopeless at this point because turbine performance is so dependent on maximum inlet duct efficiency. The most feasible approach appears to be the use of materials of high erosion-resistant qualities in the critical areas of the engine such as the compressor. In the meantime, consideration by the aircraft designer toward the location of duct entrances in lower dust-concentration areas or the use of flush-type entrances would alleviate the problem somewhat.

The comparative vulnerability of the centrifugal-flow compressor type turbine to the axial-flow compressor type turbine is an interesting problem. A test similar to that conducted on the J-35 engine is scheduled for the J-33 engine. Tests to evaluate the effect of sand and dust on auxiliary services from the compressor, such as cabin-conditioning and anti-icing systems, are planned.

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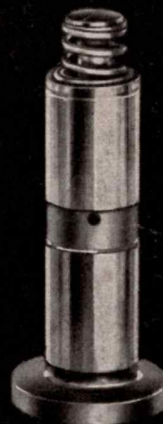
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First official photo of Beechcraft's Model 50 "Twin Bonanza." Powered by two 260-hp Lycomings, has 1000-mi range at 180-mph cruising speed. Flight-tested Nov. 15. Carries six and will sell for \$30,000

AIRFLOW SLIDE RULE

(Continued from page 66)

theoretical relation is printed on the face of the Airflow Slide Rule after the calibrated scale used to compute that function. All calculation for flow, with Mach number within the range of 0.5 to 5.0, can be made with this computer.

Two sliding inserts are used with this device. One is calibrated for temperatures in degrees Kelvin ($^{\circ}\text{K} = ^{\circ}\text{C} + 273$) and degrees Rankine ($^{\circ}\text{R} = ^{\circ}\text{F} + 460$) and in velocities in feet per seconds (*fps*) and miles per hour (*mph*). The second is calibrated for pressures in pounds per square inch absolute (*psia*) and densities in slugs per *cu ft*. The actual slug values are 10^{-4} times the printed values on the *P*, ρ slider.

The calibration of the Rule was developed from the general relations and the Mach-number functions. The general relations are:

$$(1) a = \sqrt{\gamma RT} \quad (2) V = aM$$

$$(3) \rho = 0.084 \frac{P, \text{psia}}{T, ^{\circ}\text{R}}$$

where a = velocity of sound
 γ = ratio of specific heats of air = 1.4
 R = universal gas constant
 T = free air temperature
 V = Velocity
 M = Mach number
 ρ = density
 P = static pressure

The general relations are calibrated mainly by the orientation of particular scales on the slide rule. As can be seen from Equation (1), a is a fixed function of the free air temperature. Also, from Equation (2), when $M = 1$, $V = a$.

As noted above, the temperature and velocity scales are on the same slider. Therefore, the velocity scales have been so oriented relative to the

temperature scales that, when the free-air temperature value of the flow is placed under the index line of the rule, the value of the speed sound always appears on the velocity scales opposite the $M = 1.0$ mark on the adjacent stationary scale. Also, since $V = aM$, a straight fixed scale of M values has been calibrated on the isentropic face for computing this relation.

From Equation (3) it is evident that density can be computed directly from temperature and pressure values. Pressure and temperature scales appear on different sliders of the rule. A window has been arranged on the isentropic face so that the adjacent calibrated edges of the *P*, *psia* and *T* $^{\circ}\text{R}$ scales are visible. By placing the value of *P* on the *P*, ρ slider opposite the *T* value on the *T* slider, density can be read directly on the *P*, ρ slider opposite the arrowed 84 and 840 marks (the numerical equivalent of the constant in Equation (3)) on the *T* slider. The decimal point for the absolute density value in slugs per *cu ft* must be checked mentally in this calculation.

The stationary scales on each face of the slide rule, designated by *M* followed by parentheses enclosing a ratio as a subscript (i.e. $M_{(P_0/P)}$), are the scales for computing the variable Mach-number functions. The term "variable" is used here to designate all the functions employed in calculating the absolute values of particular temperature, velocity, pressure, and density conditions. Actually, each scale is a $\log_{10}$ plot of the ratio in the subscript with *M* values marked where they occur as a function of that ratio. All the variable Mach-number functions are printed on the edges of openings in the stationary section of the rule, so the sliders may be used

with these stationary scales for computing the absolute values of the flow properties. Two "fixed" Mach-number functions also appear on the slide rule:

$$A/A^* \text{ and } M_2 \text{ where } \frac{A}{A^*} \text{ is the}$$

stream cross-sectional area expansion ratio required to change channel-flow velocity isentropically from sonic velocity to the free-stream speed. M_2 refers to the stream Mach-number after a normal shock. These are termed "fixed" functions since they always have the same value for a given free-stream Mach-number and are not used for evaluating another quantity.

Solving the fixed-Mach-number functions is merely a matter of reading the correct A/A^* or M_2 scale value opposite the desired *M* value on the adjacent *M* or M_1 scale. (M = free-stream Mach-number; M_1 = Mach-number before a normal shock wave.)

The operation of the Airflow Rule using the variable Mach-number functions is equally simple. Remembering that the *M* scales represent plots of the ratio in the subscript, and that, given a ratio and the value of the denominator (or numerator), it is necessary only to use straight multiplication (or division) to obtain the value of the numerator (or denominator), ordinary slide-rule operation is used for all the flow-quantity evaluations. That is, if a slider-scale number representing the value of the denominator in the ratio subscript of a particular scale is placed opposite the index line of the scale, the value of the numerator of the ratio in the subscript will always appear on the slider opposite the stationary Mach-number value used in the calculation.

The use of the *Airflow Slide Rule* and its simplification or ordinary air-flow calculations can be illustrated best by two problems using every scale on the device. The symbols and notations used in these examples are printed on the Normal Shock Face of the rule, as shown in fig. 1.

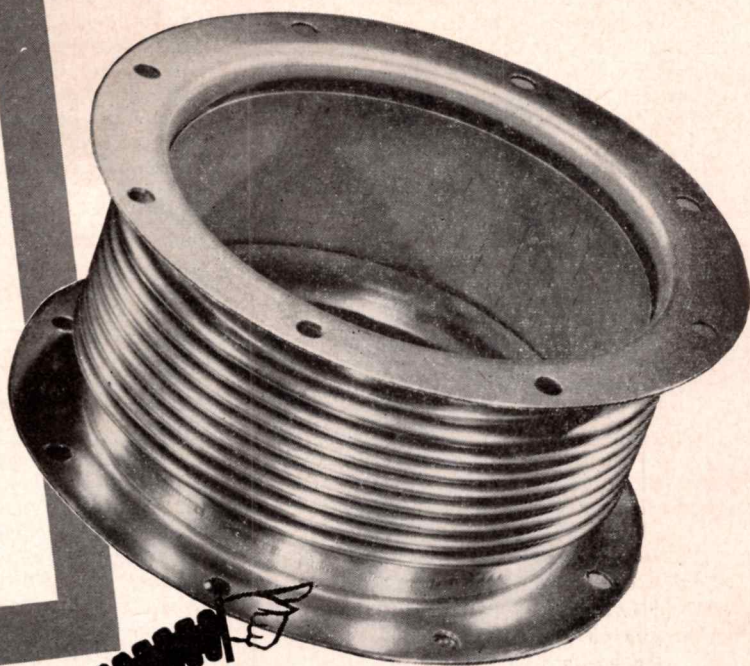
Example No. 1

A jet plane was flying at about a 10,000-ft altitude where the static pressure was 10 *psia* and the free air temperature -40°F . The pilot's Mach meter read 0.8. Assuming that these are the true flight conditions, what is the velocity of the aircraft, the speed of sound in, and the density of, the free air, and the total pressure and temperature (excluding radiation or internal cooling) experienced by the tip of the nose of the plane?

Procedure

Since *M* is less than 1.0 no normal shock wave occurs. Therefore using

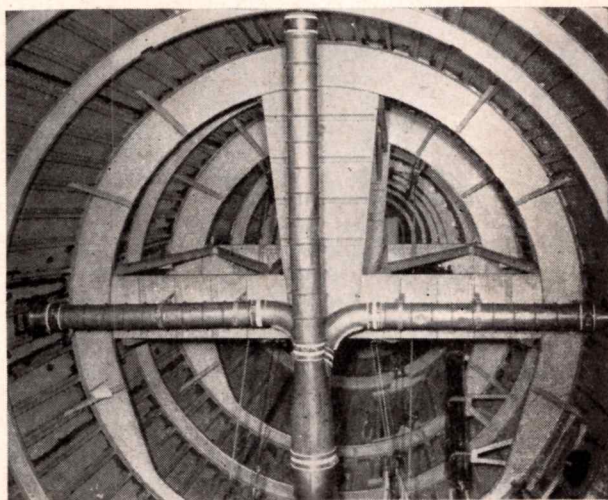
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only the *isentropic* face of rule,

1. Set $P = 10$ on the P slider scale, under the index on the left-hand side of this face.
2. Set $T = 420^\circ F$ ($460 - 40^\circ F$) on the T slider scale under the index line.
3. Read:

- (a) Above the $M = 1.0$ on the M scale, $a = 1010$ fps, or 687 mph on the V slider scales.
- (b) Above the $M = 0.8$ on the M scale, $V = 800$ fps, or 547 mpr.
- (c) Opposite the $M = 0.8$ point on the $M(T_o/T)$ scale, read: $T_o = 470^\circ R$ or $260^\circ K$, the temperature of the nose of the plane.
- (d) Opposite the 840 mark on the T , $^\circ R$ scale, read $10^5 \rho = 209$ slugs (or opposite the 84 arrow on the T , $^\circ R$ scale, read $10^5 \rho = 20.9$) on the P, ρ slider scale. The density of the surrounding air is then .00209 slugs per cu ft.
- (e) Above the $M = 0.8$ point on the $M(P_r/P)$ scale, read $P_r = 15$ psia on the P, ρ slider. This is the pressure on the nose of the plane.

Calculation time for this example: three minutes.

Example No. 2

A supersonic blowdown-type wind tunnel operates with atmospheric intake and has a test section Mach Number of 3.1. Assuming that the atmospheric conditions are $R_r = 14.5$ psia, and $T_o = 70^\circ F = 530^\circ R$, find the:

- (a) Area-expansion ratio from the tunnel throat required to produce this Mach Number with isentropic flow
- (b) Density of the intake air
- (c) Free-stream temperature, velocity, sonic velocity, and pressure in the test section assuming isentropic flow
- (d) The pressure, P_o , which would be measured by a pitot probe in the test section
- (e) The temperature, pressure, Mach Number and velocity which would exist in the stream immediately behind the normal shock wave caused by the nose of the pitot probe.

Procedure

1. Using the *Isentropic Side of the Rule*:

- (a) Below the $M = 3.1$ point on the

A
M scale, read $\frac{A}{A_*} = 4.7$ on

A
the $\frac{A}{A_*}$ scale.

- (b) Set a value of $T_o = 530^\circ R$ on the T , $^\circ R$ slider scale directly below the 14.5 mark on the P, ρ scale. Above the 840 arrow on the T scale, read $10^5 \rho R = 23.9$ or $\rho R = .00239$ slugs per cu ft.
- (c) Set $P_r = 14.5$ above the 3.1 mark on the $M(P_r/P)$ scale. Notice that the index line of the

P scale is beyond the end of the P slider graduations or that P must be less than 1 psia. To avoid lengthening the slider size, values less than 1.0 psia have not been included; but these values can be obtained easily by using the pressure values as 1/10 of the value marked on the scale. Therefore, for this present calculation, put $P_r = 145$ above the $M = 3.1$ mark on the $M(P_r/P)$ scale; and read P above the index mark of the $M(P_r/P)$ scale as $1/10 \times 3.35$, or 0.335 psia.

- (d) Set $T_o = 530^\circ R$ above the 3.1 marks of the $M(T_o/T)$ scale, and opposite the index mark of the $M(T_o/T)$ scale, read $T = 180^\circ R$ or $100^\circ K$.

Retaining the settings of the above two steps (1c and 1d),

- (e) above the $M = 1.0$ line on the M scale, read $a = 662$ fps or 450 mph on the V slider.
- (f) Above the $M = 3.1$ mark on the M scale, read $V = 2080$ fps or 1390 mph on the V scales.

2. With the same settings, but reversing the rule, On the *Normal Shock Side*

- (a) Below the $M = 3.1$ point on the $M(T_s/T)$ scale, read $T_s = 282^\circ K$ or $509^\circ R$ on the T slider.

- (b) Below the 3.1 point on the $M(P_s/P_1)$ scale, read $P_s = 1/10 \times 38 = 3.8$ psia. (It must be remembered, P is set at ten times its true value under the index line).

- (c) Above the 3.1 mark on the $M(P_o/P)$ scale, read $10 P_o = 43.8$ on the P slider, or $P_o = 4.38$ psia.

- (d) Above the 3.1 point on the $M(P_s/P_1)$ scale, read the value $M = 0.469$ on the M_s scale.

3. Using the *Normal Shock Side of the Rule*, set

- $V_1 = 2080$ fps below the 3.1 mark of the $M(V_1/V_2)$ scale. Below the index line of the $M(V_1/V_2)$ scale, read $V_2 = 522$ fps or 353 mph on the respective V scales.

Calculation time for this example: eight minutes.

A comparison of the slide-rule results with computations made by a competent computing-machine operator using Mach Number Tables data showed that this early model of the slide rule resulted in third-place accuracies.

MARKET FOR ACCESSORIES

(Continued from page 30)

and to understand its full capabilities.

To a lesser extent, VHF radio is becoming an excellent accessory. With more and more airway facilities switching over to the virtually static-free VHF frequencies, owners who may not be able to afford full omni-equipment, are finding two-way VHF for less than \$200 very desirable.

In the matter of accessories for increasing performance, sales have been particularly good on high-performance propellers. The new metal props, as well as controllable and constant-speed types, add so much to cruising speed and takeoff performance that their purchase by the private owner actually represents an economy in the long run.

There are other similar examples of merchandise which definitely are moving to the private market—tires, preservative finishes, navigation-light flashers, stall-warning indicators and other items which are now available for the first time as a result of advances in aeronautical development.

The next question seems to be, is the operator taking advantage of this situation? There are many who would be inclined to take a skeptical point of view by pointing out that the operator never could sell anything, never tried to. That's part of the apparently popular fad of blaming all of private flying's ills on the operator.

But we know differently and have concrete proof. For one thing, we

have had a long-established policy of selling only wholesale, and channeling all retail business through one of the 800 or more local-airport service operators who act as our dealers. All of the present increased sales in radio, propellers and other similar items have been placed through these dealers. We have been interested in knowing where this equipment was eventually installed.

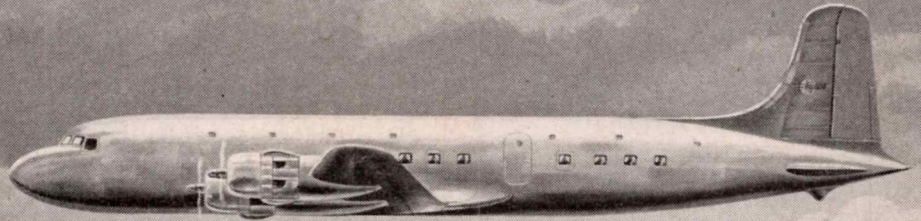
We know that virtually all of this equipment is ordered for resale to private owners. This is substantiated by the observations and experience of our field sales representatives who keep in constant touch with the operators by frequent flying trips through their territories. Each of our representatives flies his own plane equipped with all the latest accessories. He helps demonstrate this equipment to operators' prospects where the operator may not have demonstration equipment of his own. Also, our field men can observe firsthand the merchandising effort being placed by the operator. They are doing a conscientious job of pushing accessory sales and thereby adding to their profits.

One of the most interesting proofs of the sales-mindedness of the operators came to light early in the summer in response to an offer to help them in sales promotion. Their co-operation and response surprised us.

(Continued on page 80)

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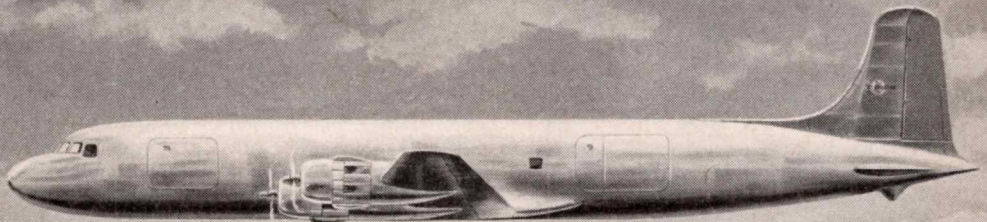
GREATER LUXURY



DC-6 *MOST POPULAR LUXURY AIR TRANSPORT* in service today is the great Douglas DC-6. Ninety-five of these swift, dependable airplanes are now in service on leading domestic airlines. The DC-6 carries more passengers in the U. S. than any other type of aircraft.

Douglas has established an unusual record for fast, reliable service on spare parts and maintenance. Swift, dependable, easy to fly and less costly to maintain—it is no wonder the Douglas DC-6 has achieved prime popularity with both flying public and airlines.

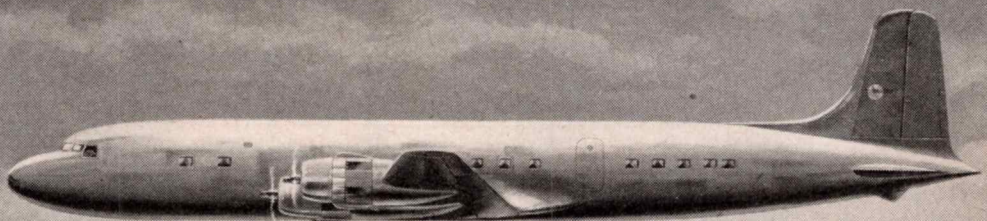
GREATER PROFIT



DC-6A *NEW "LIFTMASTER" CARGO TRANSPORT* opens new era in the rapidly expanding air cargo field. Currently being exhibited to airline officials, the "Liftmaster" is the first four-engine cargo airplane specifically designed to fill the need for a modern, medium-

size cargo airplane for military and civilian use. In contrast to the Douglas DC-4/C-54, the new DC-6A carries $\frac{1}{3}$ more cargo at $\frac{1}{3}$ less cost. The DC-6A flies 100 mph faster than the DC-4/C-54—thus making possible over-night transcontinental cargo service.

GREATER SPEED



DC-6B *THE NEW DC-6B* will be the most versatile air transport ever designed. Like the "Liftmaster," it will be 5 feet longer forward of the wing than the DC-6 and will thus accommodate 8 additional passengers in DC-6 luxury. High density models will carry up

to 92 passengers. The over-ocean DC-6B with large galley, coatrooms and lounge will carry 54 passengers in air-conditioned comfort. The 9600 hp developed by the Douglas DC-6B engines will make this the *fastest* non-jet luxury air transport in service.



In analyzing a possible way of helping the dealers to increase their own sales to private owners, we decided to start a series of direct-mail campaigns to a selected list of owners, primarily of four-place aircraft. We had to have an up-to-date mailing list, and had to have this list divided into the specific territories served by Van Dusen's three branches in Minneapolis, Teterboro, N. J., and Bedford, Mass. We sent a bulletin to our dealers telling them of our plans and asking them to fill out a form listing the names and addresses of private owners, in their respective towns, who would be good prospects. Some skeptics said the operator would never take the time and effort to make up such list. We sent the request out, anyway.

And the lists poured in! We were surprised ourselves. Names submitted were filed under each dealer's name so that any later sales would be properly credited. A mailing piece on radio equipment was sent out first to the newly acquired list. A 10% return was recorded, with these names being referred back to the dealers, who then produced a gratifying number of sales.

It has been a very encouraging and refreshing experience for us to see this increased sales-mindedness of the dealers, and it has been so for them, too, because the profits they have been making are sizable. It is even more promising in that it indicates the final emergence of a really solid group of private-plane users and advocates.

Air-Sea Search

CROCKER SNOW, Massachusetts Director of Aeronautics, suggests for the Boston district that:

A. All Coast Guard aircraft and vessels engaged in a coastal sea search shall maintain constant two-way radio voice communications with the nearest aircraft radio communications station.

B. That such station be established as the coordinating point for:

1. Informative messages from civil aircraft of value to Coast Guard vessels.
2. Instructions from Coast Guard authority to civil aircraft which may be interfering with the activities of the Coast Guard

C. That all Coast Guard vessels be equipped with standby battery-operated receivers constantly tuned to 3105 kcs, the transmitting frequency most generally available in civil aircraft

D. That there be an agreed-upon standard of visual signals from the air and from vessels.

AMC Elections

* Aviation Maintenance Corp., Van Nuys, Calif., elected three new members to the board of directors at its annual meeting in October—Warren Crowell, Walter S. Lechander and Fritz Huntsinger.

Hold-over board members include Reagan C. Stunkel, president of the firm, John G. McKean, Calvin L. Helgoe and Serge F. Ballif, Jr.

Stunkel reported that since the corporation was reactivated, in October 1948, more than \$5,000,000 in aircraft overhaul contracts have been processed in the plant, with a remaining backlog of \$1,000,000.

Cavalry For National Defense

ELLIOTT WHITE SPRINGS

MAJOR GENERAL JOE GISH, hero of San Juan Hill, says that he is ready to come out of retirement and is anxious to testify before the House Armed Services Committee to give the cavalry slant on future warfare.

"The Joint Chiefs have destroyed the offensive power of the cavalry, and imperiled the defenses of this country," he snorted. "They are putting all of my eggs into their baskets. Why, my grandson can't play polo any more and, if they keep on spending all of the appropriations on modern gadgets, what will the American people do if the enemy parachutes its cavalry into the hills of West Virginia? Our radar could not detect them, our bombers could not hit them, our tanks could not catch them, and our submarines could not get up the creek. The Cossacks are today the finest horsemen in the world. Who would save America? Call the cavalry!"

"But the Joint Chiefs have nibbled the grass from under the American horses and ruined the morale of the horsemen. All they have left to defend the country is a bunch of moth-eaten geldings. This may cost me my pension, but I must speak out before it is too late and warn the American people that the conception of global strategy is all wrong. They worship General Mitchell, Admiral Douhet, and Buck Rogers. I never agreed with Billy Mitchell. I once saw him fall off a horse. And I deplore the Atom Bomb. It is brutal and inhuman to bomb, drown, or shoot the enemy, but it is perfectly good etiquette to cut them down with a troop of well bred horse."

"It is useless to survive the next war," concluded the general, "unless our great traditions survive with us!"

GOLDEN GATEWAY

(Continued from page 61)

construction is complete. The field shape, now irregular, will be in the form of an elongated "X" with maximum runway lengths of 8000 ft and surfaces of 200,000-lb capacity. An integrated, all-weather landing system will be installed, including ILS, GCA, FIDO, slope-line approach lights, high-intensity runway lights, compass locators and surveillance radar.

San Francisco's airport ranks fifth among major U. S. air terminals in traffic volume. During the fiscal year 1948-1949, the 13 carriers using the field handled almost 23½ million lbs of cargo, almost 7 million lbs of express and more than 14½ million lbs of airmail. The number of passengers has jumped from 49,000 in 1935 to 970,000 in 1948. Similarly, in 1935 there were 16,300 transport arrivals and departures as compared with over 76,000 last year. It is estimated that, in 1949, the passenger total will rise to 1¼ million and the air-cargo total to 36 million lbs.

Scheduled flights are conducted on an average operating efficiency of 98.1% as compared with a national average of 90.5%. Private-capital investment by air carrier tenants and concessionaires is close to 10 million dollars, with 19 different types of concessions operating at the airport, including an advertising service and a flower-forwarding company.

United Air Lines' 8-million dollar maintenance base, alone, is the equivalent of a major aircraft factory, with some 2000 employees and sufficient floor space and equipment to overhaul eight 4-engine transports simultaneously. W. P. Hoare, manager of the base, reports that, during its first year of operation, 1123 engines were completely overhauled—an average of 93.5 per month—more than double the former capacity. Aircraft were overhauled at a rate of 18.4 per month as against a former 10-plane monthly maximum. The radio, electric and instrument repair shop could repair only 4000 units monthly at their previous installation;

during the first nine months of operation at San Francisco, they repaired 70,000 units.

Across the Bay, at Oakland's big, 1000-acre municipal airport (now expanding into a 2400-acre field), Orvis M. Nelson, former UAL pilot, has built Transocean Air Lines into the world's largest contract air carrier, with a record of more than 16 million air miles and 350 million passenger miles flown in round-the-world operations since March 1946.

Today, Transocean operates a fleet of 18 four-engine aircraft in global service. The company operates 16 foreign bases, has a number of subsidiary operations and, at Oakland Airport, provides jobs for almost 3000 workers at an annual payroll of 8 million dollars.

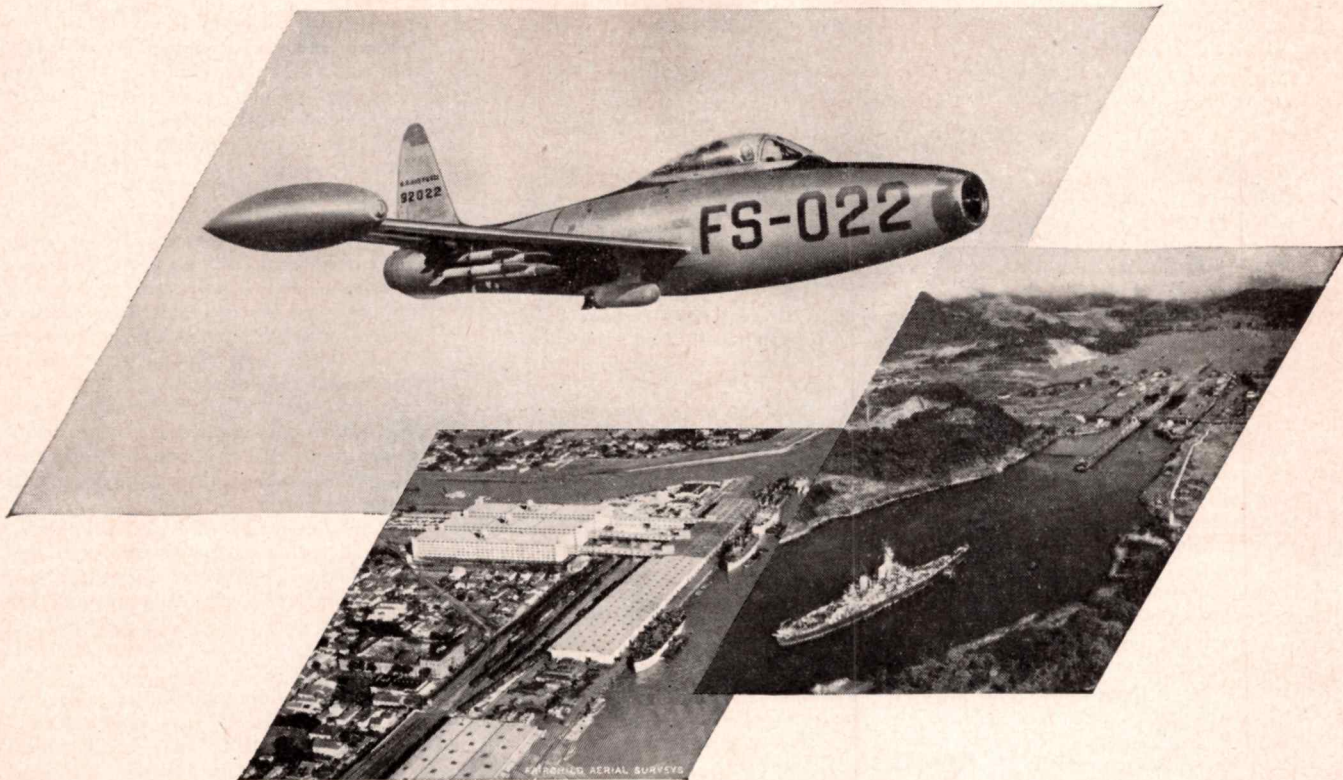
The Aircraft Engineering and Maintenance Co., a wholly owned Transocean subsidiary at Oakland, was one of three civilian firms granted contracts to overhaul planes used on the Berlin Airlift. Transocean Engineering Corp., is another subsidiary which specializes in airport construction and landing-aids installations.

Transocean also operates at Oakland the TALOA Academy of Aeronautics, one of the largest ground schools in the country, offering approved courses in piloting, navigation and flight engineering.

Oakland Airport, is San Francisco's closest competitor in the race for air traffic. Located six miles south of midtown Oakland, the airport is an all-instrument field with free and open approaches utilized since 1927. It is a strategic air-cargo base and has been fighting vigorously to take more passenger traffic away from San Francisco Airport.

It is operated by the City of Oakland, through its Board of Port Commissioners, which now has under way an extensive remodeling and modernization program, with 1700 acres planned for airport operation and 700 acres for an airport industrial section.

(Continued on page 94)



THUNDERJETS OVER AMERICA

Way down yonder . . . high above cotton fields and tobacco lands . . . more F-84's are going into active service daily . . . broadening the protective scope of our U.S. Air Force patrols. ¶ Two new models of the Thunderjet . . . the F-84-D . . . and the F-84-E . . . have been added to the Air Force's fighter arm . . . bringing even greater performance in speed, range and altitude for air defense . . . and for quick retaliation in case of need. ¶ Not just an interceptor nor an escort fighter



. . . but also a deadly fighter-bomber, carrying two thousand pounds of bombs, high velocity rockets, depth charges or incendiaries . . .



in addition to a FULL load of fuel for any required mission . . . this is the THUNDERJET. ¶ Today, F-84's protect the vast Southern

waterfront with its inland cities and farmlands . . . just as they are assigned to help guard

our East and West Coasts and Northern boundaries. Proficiency of pilots and planes

alike is kept razor sharp by



frequent maneuvers . . . high-

lighting the tactical requirements of

independent air operations,

as well as performing vitally important close support assistance to Army Ground Force

troops. Republic Aviation Corporation, Farmingdale, L. I., New York

"This is the year of the Thunderjet"

REPUBLIC AVIATION



Makers of the Mighty Thunderbolt • Thunderjet • XR-12 • XF-91



Socony-Vacuum Oil Co. of Venezuela aircraft at the company's Barinas base. Shown are a Beechcraft, Douglas C-47 and a "Navion" used in oil exploration

in a number of cities. However, enormous potentialities are unfolded in the suburbs and smaller communities and in the fields of recreation, agriculture and industry, when we envisage the omnibion in operation. It is almost redundant to point out that the roadable, zero-speed flying machine—with certain other essential characteristics—is the ultimate towards which we must strive even though intermediate compromises may well be unavoidable during its evolution.

Before any one of these products or ideas can be built, sold, or even service-tested to any extent, it is necessary that minute design details must be approved by the CAA, even though there is substantial evidence that many of the CAA-CAB standards are academic and have proved to be inaccurate gages of the actual strength or performance of structures and materials. The engineering and drafting cost for even the smallest airplane often runs to several hundred thousand dollars and several years of time. This procedure not only discourages the trial of new ideas, but tends to freeze any design so that changes, found through service tests to be desirable, are not made because of the cost and time involved in obtaining regulatory approval for them.

The sum of our studies led us to the conclusion that two specific steps will have to be taken to reserve the trend toward extinction in personal plane use and to provide the incentive necessary before ideas now existing may be translated into concrete benefits for the people of the world.

First, we felt that the aircraft-certification regulations of the CAB should be overhauled and revised—not, incidentally, an original idea with us.

We recommend, therefore, that the NASAO urge the CAB to review its CAR Parts 03 and 06 at once, substitute therefore simpler, more-realistic and technically sound regulations, probably replacing academic standards with proved results of actual flight tests.

Second, and with some reluctance, we came to the conclusion that the Federal Government is the only agency—public or private—capable of providing the money necessary for the research and development that almost everyone seems to think is necessary and possible. We tested this thought on industry, various associations, and specialists in aviation, with illuminating results.

Of eleven manufacturers who commented, seven were in favor of Government financial participation, with varying reservations as to method and details. Only one was strongly opposed, and three were more-or-

less neutral. While all of the comments are pertinent, several seem especially to merit repetition.

Piper Aircraft Corp. says in part:

"We heartily favor any intelligently conceived program which will share the costs incident to the research, experimental and development work involved in the eventual production of new models and types of aircraft. The producers of light aircraft, almost without exception, have borne these costs single-handedly, as an implicit part of their over-all cost of doing business, and this has, to a degree, made their approach to the development of new designs singularly conservative. Any such program however, must maintain in full economic focus all of the multiple factors which extend before and beyond the mere creation of a single prototype aircraft of whatever design or intrinsic capabilities."

A Goodyear Tire & Rubber executive writes:

"To summarize the situation, no one seems to deny that development funds must be forthcoming if better and more useful aircraft are to be obtained. If these development funds are to be obtained from the corporate profits of manufacturing companies, then they will not be plentiful in periods when only a very small market is available or foreseen. When only limited funds are available, private sponsorship must of necessity move slowly and cautiously in trying radical or unusual developments."

The representative of one aeronautical research organization says:

"Although I deplore the lack of risk capital and competitive, free enterprise which in the past would have made such a proposal unnecessary, I do not foresee that any radical development, improvement or increase of production of small aircraft can be assured or that a new type of personal aircraft can be widely tested for public acceptance without Government funds."

Concurrently with our general study, we drafted a bill to provide for Governmental aid in personal and industrial aircraft research and development, and asked Jerome Hunsaker, Chairman of the NACA, Lynn Bollinger of the Harvard School of Business Administration, and Delos Rentzel, Administrator of the CAA, for help in perfecting the draft. The question of who should administer the program was paramount and we soon found considerable industry objection to CAA, apparently the

most logical agency to do so.

Much informed opinion leaned toward the NACA; but Dr. Hunsaker strongly opposed such a plan as departing from the fundamental responsibilities of the NACA as a pure research organization. We also learned that the National Defense aspects of the project would have to be real and must be stressed if favorable action by Congress was to be expected. We became convinced that it will be impossible for us to write a bill that will satisfy everyone. At any rate, we finally evolved a legislative proposal which was acceptable to those most directly concerned, and to the Board of Directors of the NASAO.

In brief, this bill which "provides for the development or improvement of aircraft intended primarily for commercial or private use, but adaptable also for auxiliary military service," creates:

- (a) A National Civil Aviation Council, consisting of the Chairman of the National Advisory Committee for Aeronautics, the Administrator of Civil Aeronautics and the Chief of the Army Field Forces, which is authorized to allocate to the CAA, from funds appropriated, sums to be used for the purpose of entering into contracts or modifications thereof with an individual or company for the design, development, testing, tooling, construction, service-testing and modifications of prototypes of aircraft or the improvements of existing types of aircraft.
- (b) An advisory committee, consisting of one representative designated by each of the following organizations—AIA, AOPA, NATA, and NASAO—and three designated by the Chairman of the Council to represent the general public interest.

Our second, and final recommendation, therefore, is that the NASAO support the passage of an act of Congress based upon this bill.

BRAKE BRAIN

(Continued from page 32)

the skid detector transmits a "skid signal" to the control box, which in turn closes the circuit to energize the valve. The energized valve releases the brake pressure, allowing the wheel to recover synchronous speed. As the wheel accelerates to full speed, the skid detector sends a "recovery signal" to the control box and de-energizes the solenoid valve, thus reapplying the brake pressure being metered by the pilot.

All *Hytrol* components have been tested and proved reliable over ambient temperature ranges of 65°F. to 160°F., and an operating voltage range of 18-30 volts *d-c*. Life tests equivalent to more than 10,000 average flight hours have been completed. Low weight of the system is said to be a negligible payload consideration in view of the tire savings and safety attained for the airplane and personnel.

**GREAT FOR
LIGHT PLANES!**

**A DETERGENT-
DISPERSANT OIL!**



Proved by 10 Years' Performance in Flight Operations!

KEEP LIGHT PLANE engines in *clean condition* for fine performance—with *Esso Aviation Oil!*

IT'S MADE FROM high quality base stock . . . and it's a detergent-dispersant type lubricant specifically designed for aviation use that performs a remarkable *cleaning action* as it lubricates. When oil is changed, suspended carbon and sludge *drains out of the engine!*

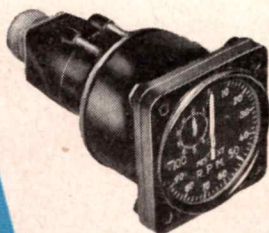
PROVED by tests run both in America's largest aviation petroleum laboratories and by a leading manufacturer of light plane engines—as well as by years of actual use in gruelling operations, under extreme temperatures.

NEXT TIME you change oil, change to the oil that helps improve the operating condition of light

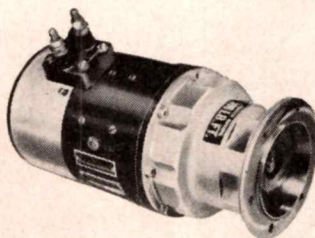
plane engines—**ESSO AVIATION OIL!** It's available in grades HD 55, HD 65, HD 80 at airports from Maine to Texas . . . wherever you see the famous Esso Winged Oval.

YOU CAN DEPEND ON

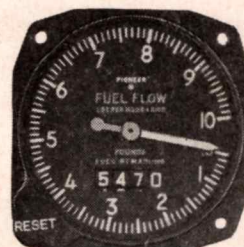




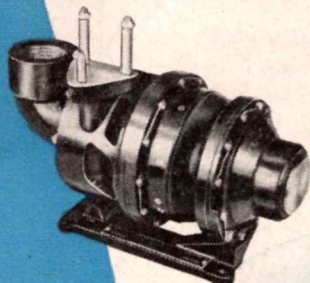
Percent Electric Tachometers



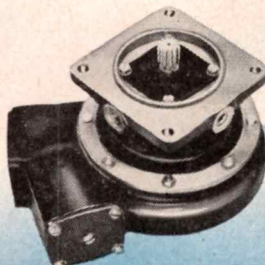
Starters



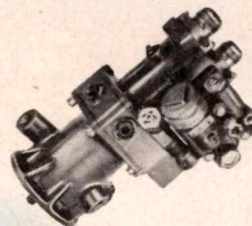
Gravimetric Fuel Flow Totalizing Systems



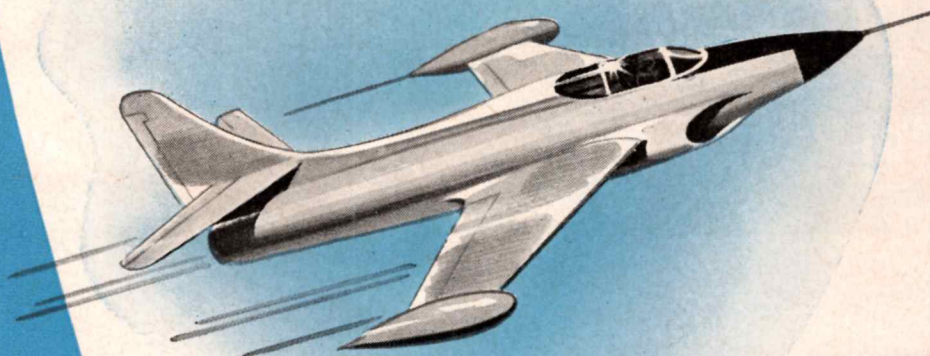
Air Turbine Driven After-burner Fuel Pumps



Fuel Booster Pumps



Lubrication Pumps



Engine Control Equipment
Air Pumps
Engine Starting Equipment
Hydraulic Equipment
Ice Elimination Equipment
Power Supply Generating
Equipment
Power Supply Regulating
Equipment



Automatic Pilots
Flight Path Control Systems
Engine Instruments
Flight Instruments
Navigation Instruments

In the JET FIELD, Too—

**FINE INSTRUMENTS AND ACCESSORIES
MAINTAINING A TRADITION OF LEADERSHIP!**

In the story of American aviation is the story of Eclipse-Pioneer. For that name has been synonymous with the growth and development of aviation in the highly specialized field of precision aircraft instruments and accessories for more than three decades. Now, that heritage of experience is proving itself in the field of jet aircraft. For today at Eclipse-Pioneer, development and production of instruments and accessories to meet the singular requirements of jet aircraft include such vital components as: Complete Fuel Control Systems • Gravimetric Fuel Flow Totalizing Systems • Engine Starting Equipment • Booster Coils • High Speed Generators • Lubrication Pumps • Fuel Booster Pumps • Air Turbine Driven After-burner Fuel Pumps • Autosyn* and Magnesyn* Fuel Pressure and Oil Pressure Indicating Systems • Electric Tachometer Systems. Detailed information about these components is available on request from responsible organizations.

*REGISTERED TRADE MARK OF THE BENDIX AVIATION CORPORATION

ECLIPSE-PIONEER

DIVISION OF

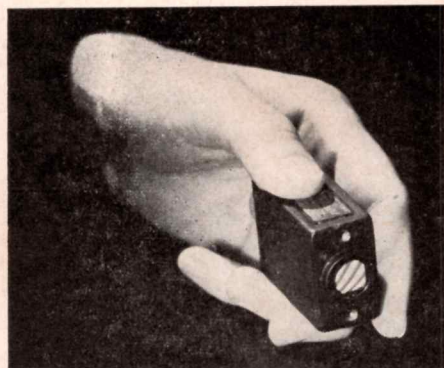
TETERBORO, NEW JERSEY



Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, New York



AERO EQUIPMENT and TRADE LITERATURE DIGEST



Position Indicators

L-2

Hermetically-sealed, DC selsyn landing-gear position indicator replaces position lights now used. By changing scale plate, instrument can be used for other switch-controlled indications requiring an On-Off function. Another instrument indicates position of wing or cowl flaps or trim tabs, regardless of degree of travel.

General Electric Co.
Schenectady 5, N. Y.

Protective Surface Coating

L-6

Clear, transparent, plastic coating for metal-and-fabric aircraft, which acts as a non-porous protective seal against oxidizing and corrosive effects of weather. Known as *Plasti-clad*, the substance is claimed to be fire- and abrasion-resistant, impervious to gasoline and extreme temperatures and acid-and alkali-proof.

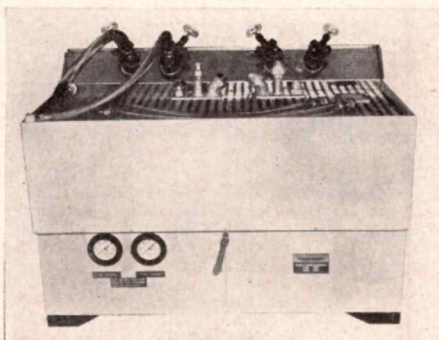
Metco Laboratory Corp.
1619 W. Wilcox St.
Indianapolis 22, Ind.

Autopilot Altitude Controller

L-4

An aneroid-actuated mechanism to control automatic pilots when altitude corrections are necessary. A Kollsman *Synchrotel* is connected to the unit through a DC magnetic clutch, which engages and permits the altitude controller, over-riding the gyro, to compel the autopilot to hold constant altitude. Responsive to as little as 2 ft in altitude change.

Kollsman Instrument Div.
of Square D Co.
80-08 45th Ave.
Elmhurst, N. Y.



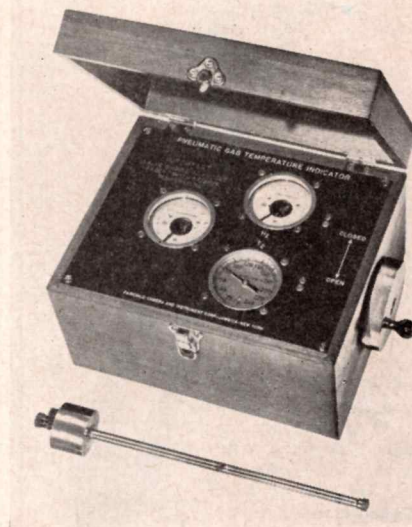
Oil Cooler Cleaner

L-1

Designed to circulate Turco *Surjex*, a chemical-soil cleaning compound for oil-temperature regulators, cleaner is equipped with a 20- gpm pump providing pressures to 80 psi. Manually operated 4-way valve

allows reversible flow and special filters on both inlet and outlet valves keep fluid clean at all times.

Pacific Airmotive Corp.
Manufacturing Div.
2940 North Hollywood Way
Burbank, Calif.



Gas-Temperature Indicator

L-3

Provides remote-reading method of measuring gas temperatures to more than 5000°F. Sample of gas, obtained by means of a water-cooled stainless-steel probe, is passed through a small iridium orifice, cooled and passed through a second metering orifice and manually operated pressure-reducing valve to atmosphere. Differential pressure drop measured at first orifice is function of temperature.

Fairchild Camera & Instrument Corp.
53 West Union St.
Pasadena, Calif.

Portable Ventilators

L-5

Equipped with high-velocity fans, powered by electricity or gasoline, ventilators provide ventilating and cooling air and draw noxious
(Continued on following page)

Write number

of item here

Name

Company

Address

..... Title

AERO DIGEST, New York December, 1949

Write number

of item here

Name

Company

Address

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AERO DIGEST, New York December, 1949

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of item here

Name

Company

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AERO DIGEST, New York December, 1949

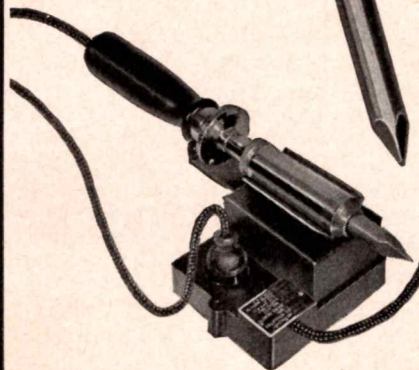
American Beauty

ELECTRIC SOLDERING IRONS

are sturdily built for the hard usage of industrial service. Have plug type tips and are constructed on the unit system with each vital part, such as heating element, easily removable and replaceable. In 5 sizes, from 50 watts to 550 watts.

TEMPERATURE REGULATING STAND

This is a thermostatically controlled device for the regulation of the temperature of an electric soldering iron. When placed on and connected to this stand, iron may be maintained at working temperature or through adjustment on bottom of stand at low or warm temperatures.



For descriptive literature write

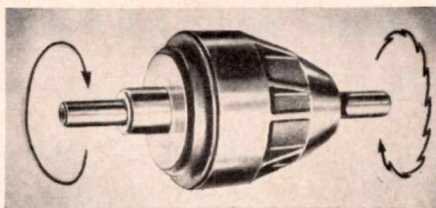
110-1

**AMERICAN ELECTRICAL
HEATER COMPANY**
DETROIT 2, MICH., U. S. A.

(Continued from preceding page)

gases or dust from the area. Two-way air-flow feature permits air duct to be connected to either inlet or discharge side of fan. Available in either direct or belt-drive models.

Mine Safety Appliances Co.
Pittsburgh 8, Pa.



Power Transmission

L-10

Originally designed as a machine-tool accessory for honing and lapping, the new *Augur Movement* has proved adaptable as a unique power transmission to convert and reduce constant-speed input to produce a quick-reversing action that interrupts rotation of output shaft every 45° of travel. Reversing action does not develop torque, counter to direction of rotation. Can be used also as agitator.

Metal Seal & Products, Inc.
21801 St. Clair Ave.
Euclid 17, Ohio

Thermal Comparator

L-11

Slide rule giving instant reading of the difference between steel and carbide gage blocks and aluminum, brass and steel material at various shop temperatures. Relationship determines exact size of work piece.

The Webber Gage Co.
12900 Triskett Rd.
Cleveland, Ohio

Molding Powder

L-12

Soft-flow, acrylic molding powder known as *Plexiglas FS* is said to offer exceptional moldability combined with clarity equal to that of heat-resistant and medium-flow powders. For use where high service temperatures are not required and promises faster cycling.

Rohm & Haas Co.
Washington Square
Philadelphia 5, Pa.

Oil Separator

L-13

Designed for use in aircraft instrument vacuum-exhaust systems. Exceeds AN 6121 requirements for oil recovery and pressure drop. Recovery exceeds 80% in any system up to 20 cfm volume. Added features include relief valve and finger screen oil outlet.

Genisco
2233 Federal Ave.
Los Angeles 25, Calif.

Pressure Switch

L-14

Approved by AMC, *Hydrol* medium-pressure switch weighs 22 oz, takes 1500 psi surge without calibration change, has operating range adjustable from 10 to 500 psi and can be used in ambient temperatures from -85° F to 200° F.

Cook Electric Co.
2700 North Southport Ave.
Chicago 14, Ill.

Spark-Plug Tester

L-34

Equipped with sparking comparator dial, providing indication of relative sparking efficiency of new and used plugs. Can be combined with any cleaning machine now in use.

Champion Spark Plug Co.
Toledo, Ohio

New Band Saw

L-15

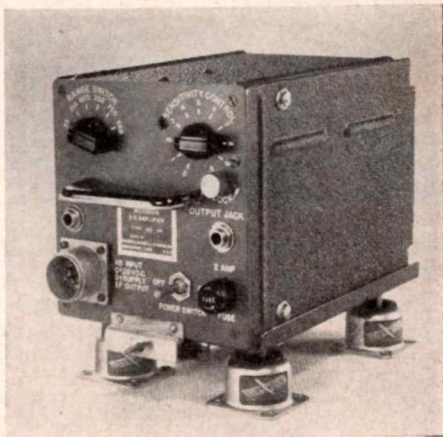
Equipped with a spiral-shaped blade, which cuts on an entirely new principle. Operator can cut and back out of any type pattern or shape without turning the material. Due to its unique form, blade presents a 360° cutting edge, having a Rockwell-C hardness of 81. Available in two models—1/3 & 1/2 hp. Blade can be used with adapter on conventional bandsaws. Tyler Manufacturing Co. Los Angeles 45, Calif.

Signal Tracer

L-16

Calibrated indications via meter, provides exceptionally accurate gain measurements. Can be used as trouble-shooter for tracing disturbance or circuit defects. Also indicates noise pickup at aerial, checks AVC-AFC, link & filter circuits.

Radio City Products Co.
152 West 25th St.
New York 1, N. Y.

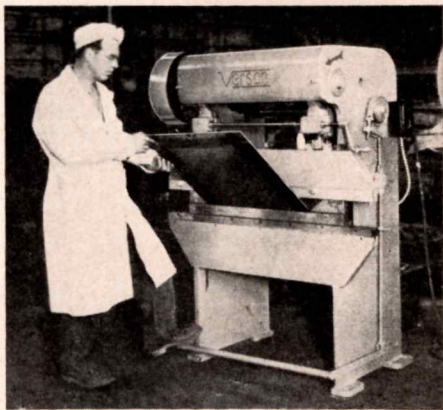


DC Amplifier

L-8

Miscroscen aircraft DC amplifier used for ground navigational signals, it can be used also with thermister bridges, strain gages, thermocouples and other low-level DC sources to operate indicators and recorders. Errors caused by variations of line voltage, ambient-temperature tube characteristics are virtually eliminated.

Manning, Maxwell & Moore, Inc.
Stratford, Conn.



Power Press Brake

L-7

Designed to replace hand-press brakes and to eliminate tying up big machines on small, odd jobs, this new brake has a bed and ram length of 48 in. Rated air-bending capacities range from a 48-in length of 16-ga stock (1/2-in opening) to a 24-in length of 10-ga stock (1 1/4-in opening) and variable-speed ranges from 20 to 50 strokes per minute.

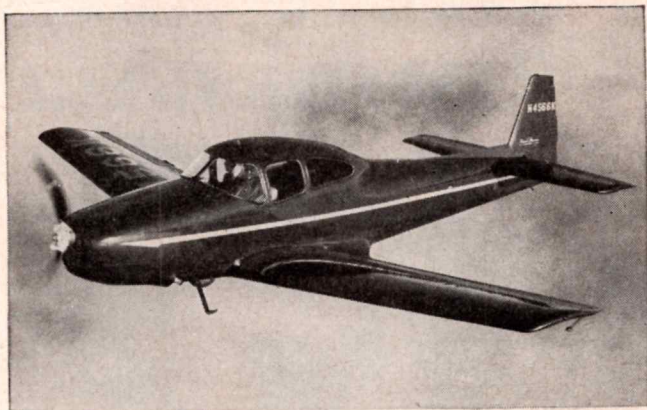
Verson Allsteel Press Co.
9342 S. Kenwood Ave.
Chicago 19, Ill.

(Continued on page 88)

You're looking at five dependable performers!



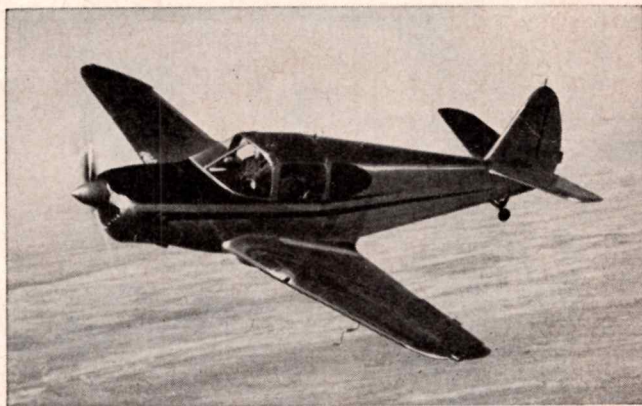
1. **DEPENDABLE**—the *Cessna 195*, a five-place, executive plane luxury liner with high wing stability that adds to flying comfort.



2. **DEPENDABLE**—the *Ryan Navion* . . . streamlined, sleek, amazingly easy to fly, it's able to make extremely short take-offs and landings.



3. **DEPENDABLE**—the *Aeronca Sedan*, a full-size, four-place airplane engineered to give excellent small field performance.



4. **DEPENDABLE**—the *Swift 125*, featuring semi-mono-coque military construction throughout. Big-plane utility, light-plane economy.

What's the FIFTH dependable performer?

Aluminum—depended upon for every type of aircraft because it is the only metal offering the combination of lightness, strength, versatility.

Depended upon, too, is a major source of aluminum, Kaiser Aluminum.

Aircraft builders know they can depend on Kaiser

Aluminum for high quality. They know it's backed by dependable service, on-time deliveries.

That's why every major U.S. aircraft builder consistently uses Kaiser Aluminum.

Produced by Kaiser Aluminum & Chemical Corporation.

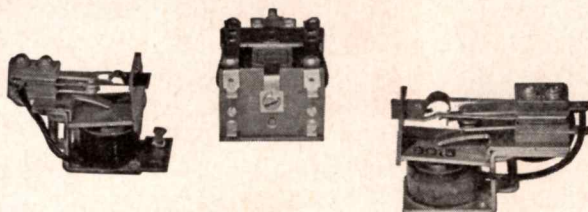
Kaiser Aluminum

SOLD BY KAISER ALUMINUM & CHEMICAL SALES, INC., KAISER BUILDING, OAKLAND 12, CALIF. . . . OFFICES IN:
Atlanta • Boston • Chicago • Cincinnati • Cleveland • Dallas • Denver • Detroit • Houston • Indianapolis • Kansas City • Los Angeles
Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Portland, Ore. • Rochester, N. Y. • Seattle • Spokane • St. Louis
Wichita • EXPORT OFFICE, OAKLAND, CALIFORNIA • WAREHOUSE DISTRIBUTORS IN PRINCIPAL CITIES

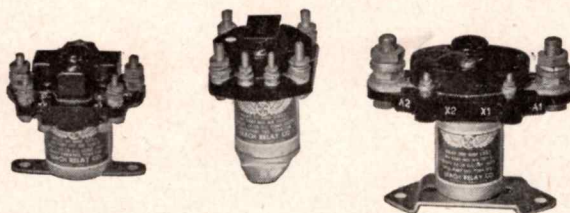
Leach RELAYS

ARE PERFORMANCE PROVED!

INDUSTRIAL RELAYS



AIRCRAFT RELAYS



SPECIAL RELAYS



You get better service from LEACH RELAYS because thousands of types of relays for thousands of applications have been proved-in-use for over 30 years.

LEACH RELAYS are designed with an exceptionally high factor of safety for *extra* dependability. Simplicity of designs makes installation quick, easy and inexpensive. Get *all* the facts and make your own comparisons. LEACH RELAYS' outstanding performance, reliability, sturdiness and economy have been *proved-in-use*.

Highest standards of engineering, materials and workmanship assure long, safe, efficient, trouble-free service.

FOR BETTER CONTROLS THROUGH BETTER RELAYS—CONTACT LEACH

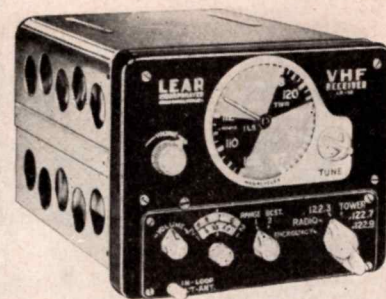


LEACH RELAY CO.

5915 AVALON BOULEVARD, ★ LOS ANGELES 3, CALIF.

Representatives in Principal Cities of U. S. and Canada

(Continued from page 86)



VHF Transmitter-Receiver L-9

De luxe unit features four receivers providing reception of all VHF facilities, low-frequency radio ranges, 75-mc marker beacons and long wave broadcast, plus a 2-watt transmitter. VHF & LF stations can be received simultaneously.

Lear, Inc.
Aircraft Radio Div.
110 Ionia Ave. N. W.
Grand Rapids 2, Mich.

TRADE LITERATURE

See Instructions on Page 85 for
Obtaining Additional Information

Bonanzaville, USA

L-17

Illustrated brochure listing flat rates on service, parts and labor for Beechcraft Bonanza overhaul, maintenance and special modifications.

Southwest Airmotive Co.
Love Field
Dallas, Tex.

Heliwelding

L-24

Description booklet on this new inert-gas, shielded-arc welding process, explains the process and when to use it, as well as containing equipment information for manual, semi-automatic and full-automatic operation.

Air Reduction Sales Co.
60 East 42nd St.
New York 17, N. Y.

Hydraulic Fluid

L-25

October issue of *Monsanto Magazine* includes a good article on *Skydrol*; new, synthetic, flame-resistant hydraulic fluid developed by Monsanto in conjunction with Douglas Aircraft and used in Douglas transports.

Monsanto Chemical Co.
St. Louis, Mo.

Plastic Coatings

L-20

Illustrated booklet offering case history of uses of *Liquid Envelope*, by Canadair, Ltd. to safeguard aircraft skins during handling, fabrication, storage and assembly.

Better Finishes & Coatings, Inc.
268 Doremus Ave.
Newark 5, N. J.

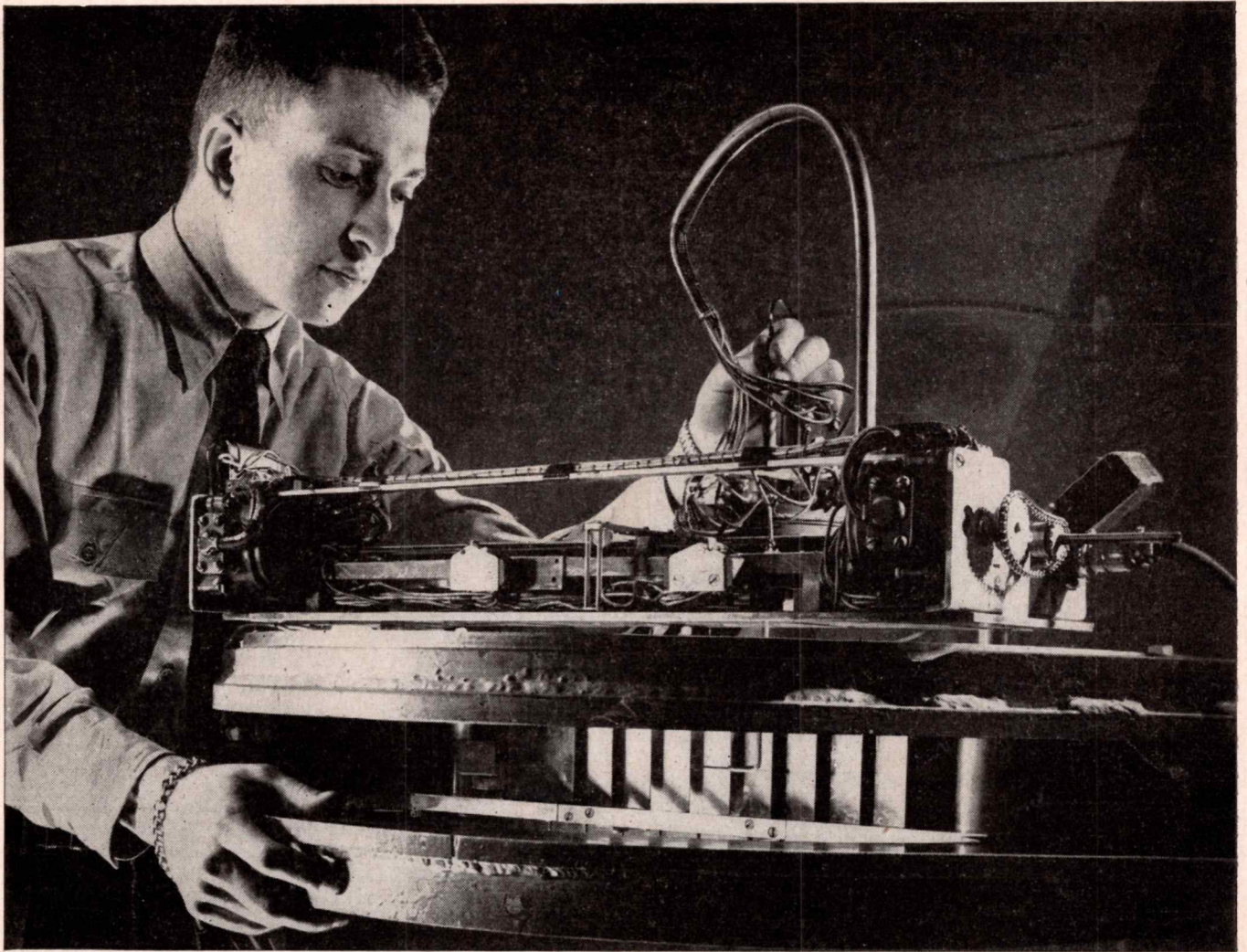
Paint-Spraying Handbook

L-21

24-page, pocket-sized booklet helps determine type of equipment best suited to your requirements, providing tips on sprayers, compressors, guns and nozzles, as well as trouble-shooting hints and techniques.

The Electric Sprayit Co.
Sheboygan, Wis.

(Continued on page 90)



A QUEST FOR THE PERFECT "SHAPE"

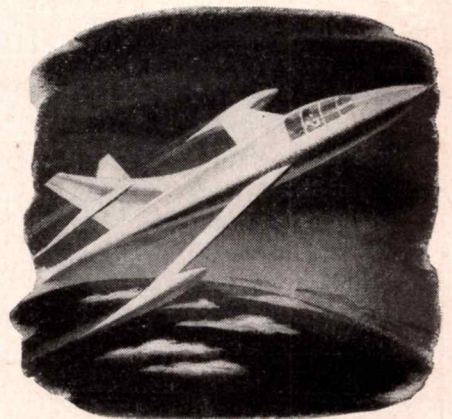
► This research engineer is seeking the best airfoil shape for the small but vitally-important blades of a jet engine turbine or compressor.

► This "wind tunnel" in the Wright laboratories can push air past the test blades at the speed of sound—an unusually high velocity for this type of equipment. The blades may be rotated in the airstream to change the angle of attack or may be assembled at various spacings to find the most efficient relationship between air and blade. Pressure readings behind the blades are picked up by a traveling probe and automatically recorded.

► There's a sound reason for this

large attention to small detail. For instance, a drop of one percent in the efficiency of the turbine section of a turbo-prop engine means a drop of three percent or more in shaft horsepower. The high speed of airflow is dictated by the fact that light weight gas turbines need the fewest possible compressor and turbine stages, which leads in turn to relatively higher speed of flow past the blades.

► This "cascade" test is one of many ways in which Wright Aeronautical Laboratories help along the "Jet Age" . . . through never-ending probing, proving and improving of all parts and materials essential to efficient jet-engine operation.



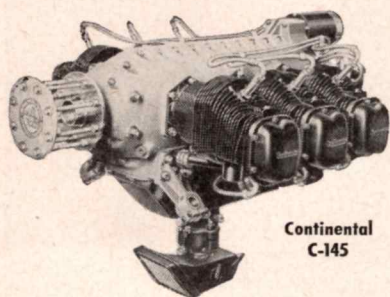
POWER FOR AIR PROGRESS

WRIGHT

Aeronautical Corporation • Wood-Ridge, New Jersey

A DIVISION OF
CURTISS & WRIGHT
FIRST IN FLIGHT

CONTINENTAL DOES IT AGAIN



Continental
C-145

Continental aircraft engines, holders of all major records, have again outdone their own previous best. The new mark of 1,124 hours and 14 minutes established by Woody Jongeward and Bob Woodhouse of Yuma in their Aeronca Sedan sets a new duration record for non-stop flight in aircraft of any type.

The C145 in Jongeward's and Woodhouse's plane consumed an average of only $\frac{7}{16}$ pints of oil an hour throughout its record-breaking flight. Gasoline consumption averaged only 8.4 gallons an hour. Like the C145 used by Bill Barris and Dick Riedel, this engine was strictly stock.

Coming as it does on the heels of the Barris-Riedel record flight, the Jongeward-Woodhouse record underscores again the day-in-day-out dependability of Continental power. Moreover, it helps account for the ever-wider adoption of Continental-powered planes for ordinary workaday use, by business and industrial firms, on farm and ranch—wherever speed, safety and dependability count.



**Continental Motors
Corporation**

AIRCRAFT ENGINE DIVISION
MUSKEGON, MICHIGAN

(Continued from page 88)

Motorized Centers

L-18

Catalog describing new grinding attachment for use on surface grinders, jig borers, jig grinders, drill presses and light milling machines. Action photos show attachment's many uses, including taper and contour grinding and face-plate work.

Moore Special Tool Co. Inc.
Bridgeport 7, Conn.

Crew Seating Chart

L-19

Wall chart listing all pertinent information for aircraft-crew seating, including load requirements, dimensions of adjustment and prominent features. All available models of crew seats are illustrated with data for each.

Aircraft Div.
Weber Showcase & Fixture Co., Inc.
Huntington Park, Calif.

Coordinate Recorder

L-37

Brochure describing new, high-speed rectangular-coordinate recording system, used for plotting voltage or its logarithm as a function of time, or of the displacement angle of a measured element. Gives complete data on all units.

Airborne Instruments Laboratory, Inc.
160 Old Country Road
Mineola, N. Y.

Non-ferrous Castings

L-23

72-page illustrated book containing information on casting of aluminum, magnesium, brass, bronze, zirconium and rare earth. Castings by Howard also lists numerous tables showing mechanical properties, chemical analyses and physical characteristics of these metals.

Howard Foundry Co.
1700 North Kostner Ave.
Chicago 39, Ill.

Helical Gear Drives

L-22

Engineering manual containing complete ratio information, hp-rating tables, selection procedure, overhung-load capacities, assembly diagrams, dimensions and weights of new line of *Maxi-Power* enclosed helical-gear drives.

Foote Bros. Gear and Machine Corp.
4545 S. Western Blvd.
Chicago 9, Ill.

Fitting Shape Chart

L-36

Horizontal, 4-leaf gatefold that can be mounted on wall or placed in ring binder, showing 266 types of hose, pipe and NAF-series fittings. Reverse side lists data on identification, sizes, materials and interchangeability.

The Parker Appliance Co.
17325 Euclid Ave.
Cleveland 12, Ohio

AVIATION EARNINGS

American Airlines, Inc. reported a net profit of \$5,935,000 for the nine months ended Sept. 30, 1949, compared with a loss of \$3,416,000 for the same period in 1948. On Oct. 19, AA declared the regular quarterly dividend of \$.875 per share on its \$3.50 cumulative convertible preferred stock.

On Oct. 12, Beech Aircraft Corp. voted a quarterly dividend of 25c per share on its common stock, the fourth consecutive quarterly cash dividend in the corporation's 1949 fiscal year. Beech's present backlog is approximately \$13,000,000.

Boeing Airplane Co. reported net earnings of \$1,117,826 for the third quarter ended Sept. 30, 1949, bringing to \$1,780,175 the total net earnings for the first nine months of 1949. The company listed a backlog of \$302,488,787 as of Sept. 30. New orders since the first of the year totaled \$100,614,495 (net after terminations). A dividend of \$1.00 per share was declared on Oct. 24.

Net earnings of Clark Equipment Co. for the period ended Sept. 30, 1949, were \$2,482,567. Current assets of that date were \$24,854,105; liabilities were \$5,431,579.

Net profit of Consolidated Vultee Aircraft Corp. for the quarter ended Aug. 31, 1949 totaled \$1,112,558, bringing the profit for the first nine months of the fiscal year to \$2,697,885. For the corresponding period of 1948, the corporation showed a loss of \$8,109,139.

Net income of Douglas Aircraft Co. for the first nine months of fiscal 1949 was \$5,152,977, compared with \$1,950,795 for the same period of 1948. On Aug. 31, the Douglas backlog was \$223,256,062, an increase of approximately \$23,000,000 over that of May 31. 94.3% of the total backlog is military orders.

Fairchild Engine & Airplane Corp. declared a dividend of 35c per common share payable Dec. 5, 1949.

McDonnell Aircraft Corp. reported net earnings for the year ended June 30, 1949 of \$1,731,832 and listed a backlog of \$61,896,041.

Northwest Airlines, Inc. showed a net profit of \$1,984,104 for the first nine months of 1949, compared with a net loss of \$2,120,251 for the same period in 1948.

Pacific Airmotive Corp. announced that, because of the company's favorable cash position as of Aug. 31, 1949, it was able to make a bank-loan payment of \$500,000 which was not due until Dec. 31, 1949. The company reported a loss of approximately \$33,000 for the first three quarters of the fiscal year, as compared with a loss of approximately \$90,000 for the same period of 1948.

On Sept. 12, Texas Engineering & Manufacturing Co. declared the regular quarterly dividend of 10c a share on its common stock.

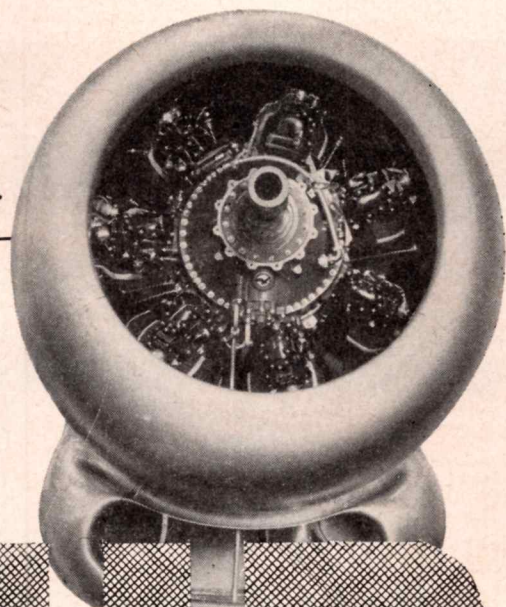
United Air Lines reported a net income of \$2,886,328 for the third quarter of 1949, thus showing a net income of \$2,710,574 for the first nine months of 1949.

Air Force Contract

The airplane division of Curtiss-Wright Corp., Columbus, Ohio, has been awarded a \$1,200,000 contract by the Air Force to produce spare parts for C-46 Curtiss *Commando* airplanes.

The production program includes landing-gear assemblies, ailerons, fins, doors, struts and miscellaneous small parts and assemblies. Final deliveries on this order will not be completed until March, 1951.

Power package for the B 50 completely built and assembled by Rohr

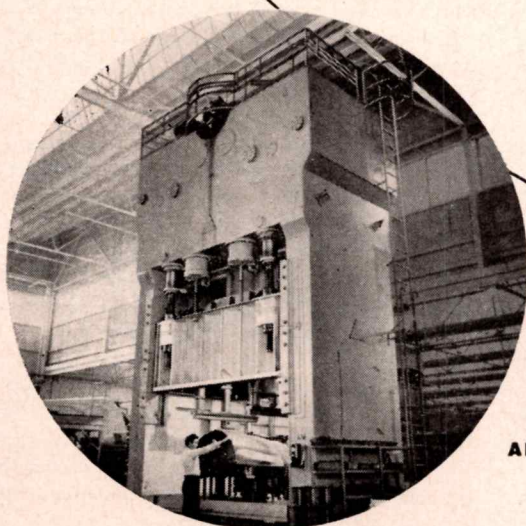


**MORE AND MORE
THEY'RE LOOKING TO**

ROHR

The combination of engineering ability, production skill, good machinery and long experience adds up...and at ROHR it adds up to producing the things you want better! faster! cheaper! ROHR is now making products for such fine companies as Boeing, Convair, Lockheed, North American...and more. What can ROHR make for you — better! faster! cheaper!

ROHR'S giant 750 ton double-acting mechanical press — biggest in this area.



ROHR

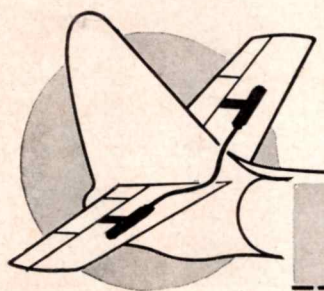
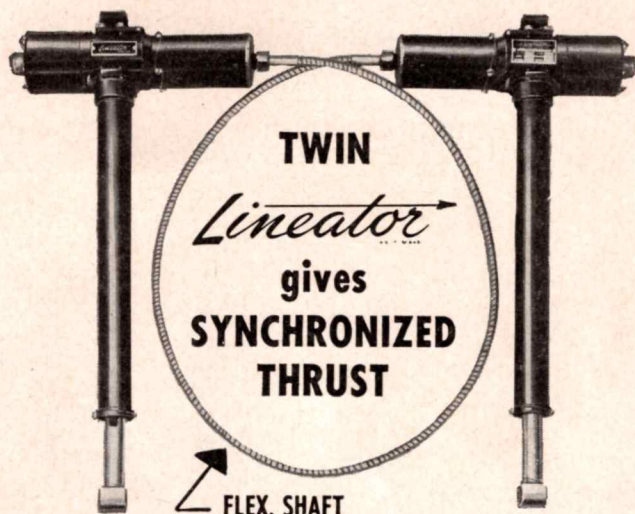
AIRCRAFT CORPORATION

Learn more about ROHR...Write for free illustrated, 24-page brochure.

In Chula Vista, California... 9 miles from San Diego

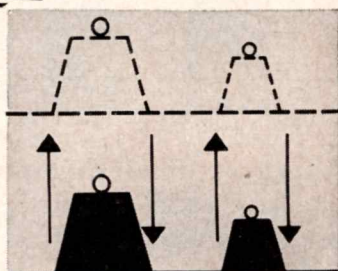
Lineator ELECTRIC

LINEAR ACTUATOR



TWIN Lineator
for synchronized
aircraft tab
control

TWIN Lineator
keeps unequal
loads in step



For aircraft and industrial application the improved model Lineator (electric linear actuator) is finding ready acceptance as a solution to the problem of providing thrust at an *identical* rate in separated locations. The improved Lineator incorporates a unique mechanical synchronization feature which keeps unequal loads positively in step. A light flex. shaft connecting separated units handles only the *differential* power.

- Separation of power units simplifies installation.
- Reduces power requirement.
- Increases service life.



ACCESSORIES CORPORATION

25 MONTGOMERY ST. • HILLSIDE 5, NEW JERSEY
6926 MELROSE AVE. • HOLLYWOOD 38, CALIFORNIA
W. N. WRIGHT • DALLAS, TEXAS

Names in the News

*Personnel changes and promotions
in aviation and allied industries*



Gall



Crago



Fitzpatrick



Berry

- ARTHUR H. ABEL, port manager and chief engineer of the Port of Oakland, Calif., has been elected president of the American Assn. of Port Authorities.
- JOHN DEREK AHLERS has joined the New York staff of The Babb Co., Inc. as aircraft sales representative.
- Air Reduction Co., Inc. announces that H. R. SALISBURY has been appointed president. Appointed vice-presidents were: H. F. HENRIQUES, J. J. LINCOLN, JR., S. B. STOFFER and N. L. WISSER.
- B. A. BANNAN has been appointed general manager of Western Gear Works and all affiliated plants.
- JOSEPH T. BARTA has been named aircraft sales manager of William C. Wold Associates, New York representatives of Consolidated Vultee Aircraft Corp.
- THOMAS M. BELSHE, member of the board of directors of Lear, Inc., has been named vice-president of that corporation.
- J. H. BERRY has been appointed to the newly-created post of director of manufacturing for A. V. Roe Canada, Ltd.
- JOHN L. COLLYER, president of B. F. Goodrich Co., has been elected a trustee of the Alfred P. Sloan Foundation and has been named to the Munitions Board Advisory Committee on Military-Contractor Relations.
- SAMUEL P. CRAGO has been promoted to asst. factory manager of Hamilton Standard Div. of United Aircraft Corp.
- FRED DENIG, vice-president of the Koppers Co., Inc., has been named manager of the company's production dept.
- ANDRE DE SAINT-PHALLE has been elected chairman of the board of California Eastern Airways, Inc.
- G. A. FITZPATRICK, formerly superintendent of jet fighter production of Lockheed Aircraft Corp., has been made works manager for the corporation.
- R. C. FULLER, asst. general manager of the Pacific Div., Bendix Aviation Corp., has been named general manager of the division.
- RONALD S. GALL has been appointed public relations manager of the Propeller Div. of the Curtiss-Wright Corp.
- MARK GARDNER has been elected president of International Derrick & Equipment Co., a subsidiary of Dresser Industries, Inc.
- DANIEL J. HAUGHTON, formerly asst. to the vice-president manufacturing of Lockheed Aircraft Corp., has been named president of Airequipment Corp., a wholly-owned subsidiary of Lockheed, and of Aerol Co., Inc., an Airequipment subsidiary.
- SALVIANO R. HERRERA has been appointed director of North American operations for FAMA (Flota Aerea Mercante Argentina), the Argentine Airlines.



HOTEL STRAND

ATLANTIC CITY'S
HOTEL of DISTINCTION

Devoted to the wishes of a discriminating clientele and catering to their every want and embracing all the advantages of a delightful boardwalk hotel.

Spacious Colorful Lounges—Sun Tan Decks atop—Open and inclosed Solaria—Salt Water Baths in rooms—Garage on premises. Courteous atmosphere throughout.

When in Atlantic City visit the
FAMOUS FIESTA LOUNGE
RENOWNED FOR FINE FOOD

OPEN ALL YEAR
Under Ownership Management
Exclusive Penna. Ave. and Boardwalk

Accepted the World Over

as the STANDARD Distress Signal

DAYNITE

REG. U. S. PAT. OFF.

SMOKE FLARE DISTRESS SIGNALS

MILITARY DESIGNATION

SIGNAL (DISTRESS DAY AND NIGHT) AN MARK 13 MOD O

Standard Distress Signal of the U. S. Armed Forces and adopted by the Governments of Argentina, Australia, Canada, Chile, Netherlands, Netherlands Indies, Portugal, Sweden, etc.

Exclusive DAYNITE construction hermetically seals each individual signal in metal... guarantees moisture-proof dependability! Day and night protection of vivid orange smoke signal and brilliant red flare in opposite ends. Obsolete pistol projected, floating and paper-wrapped, fireworks-type distress signals.

Approved by U. S. Coast Guard No. 160.023/1/0
Approved by Civil Aeronautics Authority and specified by Air Transport Association



AERIAL PRODUCTS, Inc. ELKTON, MARYLAND
WORLD'S LARGEST MANUFACTURER OF DISTRESS SIGNALS

• DR. FRANK B. JEWETT, former president of the National Academy of Sciences and of the AIEE, will be awarded the Hoover Medal for 1949. The award will be presented at the Winter General Meeting of the AIEE in New York.

• ROBERT T. KENNEY has been named director of public relations of the aircraft div. of Fairchild Engine and Airplane Corp.

• Lapointe Machine Tool Co. of Hudson, Mass. announced the opening of their new, enlarged offices in Chicago. Address is 2400 West Madison St., with JAMES W. DOPP, GEORGE A. HODGES, JR. and RICHARD S. DAVIS as sales and service engineers.

• W. B. LENKARD has been named asst. general manager in charge of the airport market of Gulf Oil Corp.

• R. W. MARKLEY, JR., formerly assistant to director of Contract Requirements of Douglas Aircraft Co., has joined the Aircraft Industries Assn. as assistant to

director of Industry Planning Service.

• CHARLES E. McCUAN, formerly Mid-Continent branch manager of Saval, Inc., has been transferred to Los Angeles as sales manager for all Saval aircraft products.

• COL. CLYDE H. MITCHELL, commanding officer of the Fifty-Second Fighter Wing, N. Y. National Guard, has been promoted to brigadier general.

• BURT C. MONESMITH has been appointed assistant to the vice-president-manufacturing of Lockheed Aircraft Corp.

• Pacific Airmotive Corp. announces that BRUCE H. ATWATER, former manager of the Oakland Div., is now manager of the Eastern Div. at Linden, N. J.; RAYMOND E. VAIL has been appointed acting div. manager of the Oakland Div., and CECIL O. BRYANT, manager of the Anchorage Div. in Alaska.

• FRANK B. POWERS, formerly asst. vice-president—production of American Car & Foundry Co.,



Haughton



Monesmith



Markley



Fuller

has been appointed director of manufacturing operations of Federal Telephone and Radio Corp.

• WALTER M. REYNOLDS has been elected secretary of the Morse Chain Co., a division of Borg-Warner Corp. He retains his post as controller of the division.

• The Frank W. Taylor Co., DeWitt, N. Y., was appointed representative for Cannon Electric Development Co., Los Angeles, to handle the company's connector lines on Schedule "A".

• FRANK T. TUCKER, director of advertising of The B. F. Goodrich Co., celebrated his 30th anniversary with the company in August.

• E. S. THOMPSON, manager of

sales for the Aircraft Gas Turbine Div. of General Electric Co., has been appointed to the Daniel Guggenheim Medal Board of Award.

• GEORGE C. VAN NOSTRAND has been elected vice-president and general manager of American Airlines de Mexico.

• JACK VICTORINE has been appointed general sales manager of the Cooper Alloy Foundry Co.

• MICHAEL J. WARDELL has been appointed eastern regional director of public relations for American Airlines, with headquarters in New York.

• DANIEL R. WINTER has been appointed asst. general manager in charge of transportation sales for Gulf Oil Corp.

(Continued from page 80)

The Board's master plan contemplates construction of three sets of parallel 10,000-ft runways.

Starting point of the Maitland-Hegenberger, Dole Race, Smith-Bronte and Kingsford-Smith transpacific flights, the airport was the Pacific Coast base for the Naval Air Transport Service during the war. Now located at the field are Pacific Airmotive Corp., Helicopter Services of Calif., Aero Industries Technical Institute, Dade Brothers' aviation packaging plant, a Naval Reserve Air Station and the Transocean operation, as well as innumerable non-certificated carriers.

Los Angeles, admittedly, has the edge on the Bay Area in numbers and size of aircraft-manufacturing plants. This "edge" was pushed back slightly by the emergence in recent months of United Helicopters, Inc., as the world's largest manufacturer of commercial rotary-wing aircraft. Situated at Palo Alto, 32 miles down the peninsula from San Francisco, United is the brainchild of Stanley Hiller, Jr., one of the youngest aircraft manufacturers ever to attempt the building of aircraft.

Aviation-wise, the Bay Area is rapidly establishing a nationwide reputation for imagination and ingenuity. San Mateo, a peninsula community with a string of

private airports bordering its limits, recently concluded a week-long "Fly In and Shop San Mateo" program, bidding for the patronage of Northern California's private-plane owners, of which there are more than 2000 in this 10-county Bay Area. Visiting pilots landed within two blocks of the community's shopping district and automobiles were made available for pilots who wanted to go downtown.

Napa Airport

The Napa County Airport, in the northern part of the Bay Area and the Palo Alto Municipal Airport on the peninsula, are excellent examples of community-airport development prompted by hardworking private pilots and aviation-minded community leaders. This field, after four years of operation, is on a break-even basis and, according to Manager Frank Bishop, closely approaches the "black ink columns." Located half-way between Napa and Vallejo, the Napa County Airport has competition from four Class 1 airports immediately adjacent to the two towns.

The Napa Airport has been developed along informal, club-like lines, with attractive lounge and clubroom furnished with comfortable furniture, magazines, newspapers, cards, card tables and a piano for the musically inclined airmen. Its restaurant enjoys a reputation as one of the finest steak houses in the north Bay Area.

The only commercial air-carrier activity is that of Southwest Airways, which serves Napa and the surrounding communities in its "feederline" operation. All leaseholds at the field are paid for on a percentage-of-gross-receipts basis, and the airport management shares in the success of the field on a commission arrangement.

Other airports in the Bay Area dedicated to personal aircraft are Palo Alto, Bay Meadows (adjacent to the famed race track), San Mateo, Belmont Airport, Buchanan Field and Sherman Field at Concord, the Municipal Airport at Hayward, San Carlos Airport and the Stockton Municipal Airport.

Although Bay Area aviation leaders are doing reasonably well at the present, they are not resting on their laurels but are looking to the future. Under the stimulation of the Bay Area Aviation Committee, chairmanned by Weldon E. Vance of Berkeley, and the Bay Area Council, the San Francisco Bay Area Airport Planning Group has just completed and published an intensive study of the airport needs of the entire area.

Recommending establishment of short-hop routes linking Bay Area centers of mail receipts and deliveries, the Planning Group envisions a need for 22 new airports by 1960, including "heliports" on the roofs of downtown office buildings.

Expectations

The Planning Group's 123-page report predicts that the Bay Area may expect, by 1960, three times the passengers and peak-hour plane movements that exist today, along with six times as many private planes—or 10,400 privately owned aircraft (figs 1 and 2).

In spite of San Francisco's already huge International and Domestic Airport and plans for its extensive development, the

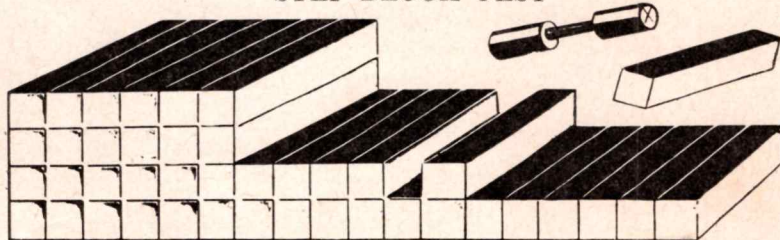
NO HEAT TREATMENT means GREATER CASTING STRENGTH and UNIFORM PHYSICAL PROPERTIES in each casting made from FRONTIER 40-E ALUMINUM ALLOY

Strength and absence of brittleness are obtained in Frontier 40-E Aluminum Alloy without heat treatment. In addition, special properties such as exceptional shock resistance and machineability are achieved, assuring superior performance of aircraft parts and products made from this high-quality aluminum alloy.

Extensive step block tests made by casting individual test bars and com-

paring them with coupons cut from the casting, as illustrated, definitely show that the physical properties of 40-E in a casting are approximately those of separately cast test bars. Note that each of 42 coupons cut from the casting met Army-Navy-Air Corps Specification A-N-A-17—an important factor when considering castings for greater strength and resistance to distortion and shock.

STEP BLOCK TEST



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Y.P.	22.5	20.0	21.2	20.6	20.5	22.0	20.8	21.0	21.8	22.5	23.0	23.4	23.0	25.0	23.8	22.5	23.5	24.6
T.S.	36.3	33.0	33.1	32.7	33.8	36.0	33.8	32.5	33.5	34.5	39.0	37.2	37.8	39.0	36.8	36.5	36.7	40.0
El.	12.5	10.0	6.0	4.0	7.5	7.5	8.0	7.0	7.0	7.5	7.0	8.0	8.5	8.5	7.5	8.0	7.5	10.0

ALLOY 40-E - Heat 774A

	Y.P.	T.S.	El.
ZN	5.52		
Mg	.55		
CR	.47		
FE	.39		
TI	.23		
CU	.22		
SI	.14		
MN	.15		

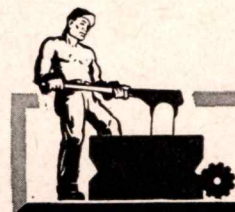
STEP BLOCK BARS

	MAX.	MIN.	AVER.
YIELD	22,500	22,500	22,700
TENSILE	40,800	32,500	35,500
ELONGATION	11.0	5.0	7.5

NAT. AGE
21 days at R.T. x x x
Test Bar Cast Separate
Aged 21 days at Room Temperature

Y.P.	23,500
T.S.	36,600
El.	7.5

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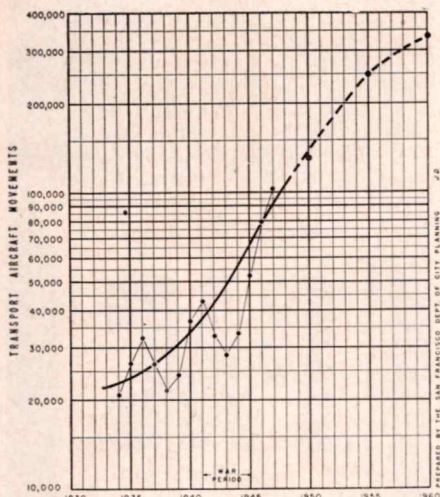


Figure 1

Planning Group envisions the need for San Francisco by 1960 of two class 1 airports at Hunter's Point and at Treasure Island, plus a seaplane base at the Ferry Building.

The voluminous report concludes that:

- (1) Insufficient runway and storage capacities for private aircraft constitute the greatest lack in present Bay Area aircraft facilities, with immediate action required
- (2) Existing Class 3 and 4 airports which can handle transport as well as private aircraft, provide capacity adequate for the next decade for all but a few districts in the Bay Area
- (3) San Francisco and Oakland airports are able to furnish adequate runway capacity for all trunkline aircraft-transport operation in the area through 1960, provided that a comprehensive development program is followed. Required improvements are:
 - (a) Installation of aids to air navigation, traffic control and landing
 - (b) Development of airports for optimum operating efficiency
 - (c) Improving accessibility of existing terminals to communities and rural areas they best serve.

From a military point of view, the Bay Area has more than its share of military aviation installation, ranging from headquarters of the 4th Air Force at Hamilton AFB to the MATS installations at Fairfield-Suisun and the Navy's Fleet Logistics Support Wing at Moffett Field on the Peninsula. Naval Air Stations at Alameda, Oakland

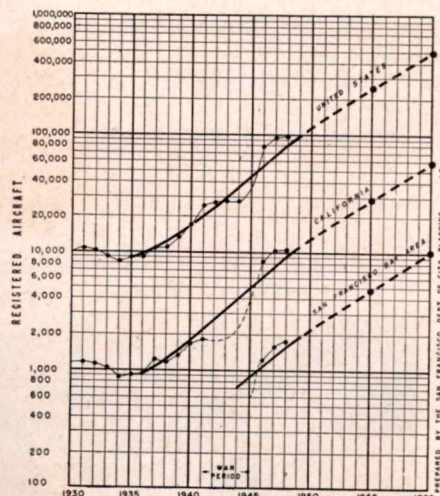
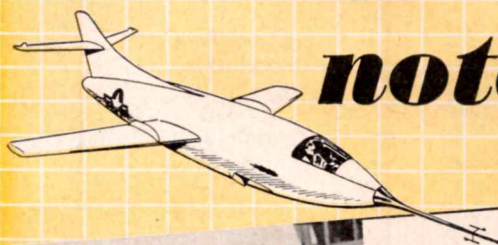


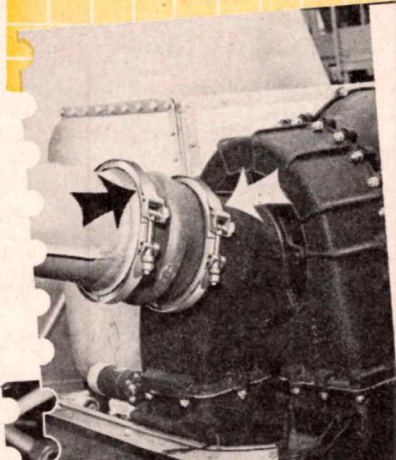
Figure 2

engineer's notebook



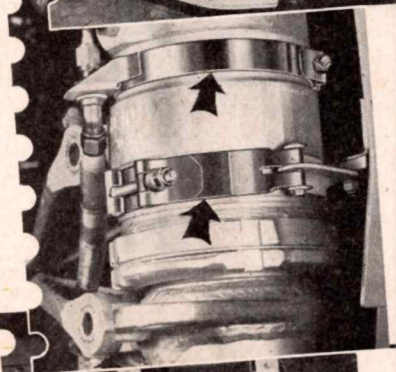
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Final evidence of the air-mindedness of the area is the fact that three of the four daily San Francisco newspapers have active aviation editors and aviation columns, as do the two Oakland dailies. Even the smaller community newspapers along the peninsula have aviation writers, and aviation receives extensive radio coverage.

COST FACTORS

(Continued from page 25)

been explored fully in this regard. It would tend to reduce the basic manufacturing cost as well as maintenance cost.

Plastic Parts.—The modern design tendency is to use many parts which may be fabricated quickly from plastics such as trim and molding, in the interior of the plane. While the costs of these items are small, their frequent replacement because of rough handling, humidity, and temperature conditions becomes necessary. Therefore, before plastic parts are used, an evaluation should be made as to whether these parts will be durable or not.

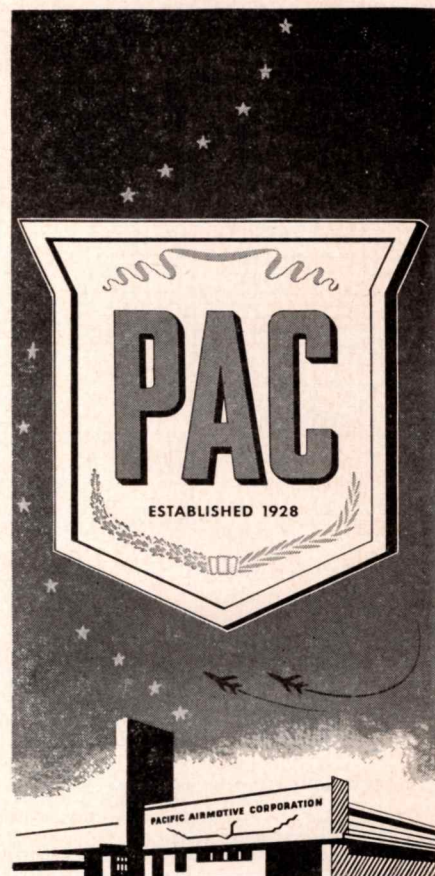
Control-Surface Balancing.—On wartime air transports, the removal of several inspection-access plates in the control-surface leading edges is necessary when the control surfaces are recovered and balancing is necessary. This requires several man-hours to accomplish prior to and after the balancing operation has been completed. Therefore, the use of a static balance externally located inside the fuselage aft section is desirable. Later designs, in some instances, provide for this.

Inspection-Access Plates.—Inspection-access plates are attached by slotted-head screws. Regardless of screw attachment, it would be advantageous if these plates could be used interchangeably without the necessity of matching the plate to the opening from which it was removed. Where possible, sizes of the plates should be such that a minimum number of different plates will be possible and have the same number of holes. This part is an attrition item, and plates, as now made, do not have long maintenance life. Replacements are frequent, and they usually require local fabrication. Also, the type of screws used should be standardized, because they are made of heat-treated steel and may not always be available when needed the most.

Station Numbers.—Station-number stencils should be marked on the circumferential frames of the fuselage, or the ribs of the wings. Practically no means are provided at present to show this in a specific manner.

Rework of Actuating Parts.—Actuating components of functional mechanisms frequently require extensive rework to return these parts to serviceability. Where possible, provision should be made in the design of functional parts for rework by conventional machine tools. This obviates the necessity of purchasing new parts and decreases the cost of repair operations.

Special Tools.—Considerable attention



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to the initial detail design of airframe components should be directed so that special tools other than those commercially available will not be necessary. Special tools increase the overhaul costs because the tool inventory at maintenance facilities must be extensive. Any additional tools, other than those normally necessary, increase the tool investment.

Heavier Cargo-Door Treads.—On cargo air transports, the door treads should be of heavier aluminum alloy or stainless steel. Frequent structural repairs must be made to this part of the structure.

Draining of Fuel.—It frequently is necessary to drain fuel from the integral fuel tanks during tank inspection or repair work. Provision should be made so this can be done with a minimum loss of time. Drain lines should be enlarged in diameter.

Auxiliary Powerplants.—The use of a gasoline engine-driven auxiliary electrical powerplant is becoming to be more and more beneficial, regardless of the imposed weight penalty. Because cargo airplanes operate all over the world where external electrical power is not always available, it is necessary that they shall have a self-contained means of supplying it. It is usable in flight also to supplement the engine-driven generators during heavy drains on the batteries.

Parts Catalogs.—It would be of assistance to maintenance facilities, also if those parts which definitely are of attrition nature—such as packings, special bushings, seals and items that must be replaced because of wear on a periodic basis—would be marked conspicuously and coded in the parts catalogs. This would make it possible for maintenance personnel to requisition the necessary replacement parts quickly. Obviously, all parts which possibly may wear should not be included, but, in general, those parts which are known in advance to require periodic replacement should be included. It should be possible also to provide in advance kits of overhaul parts of the functional components for convenient stock-room and issue purposes.

Main-Cabin Interior Parts.—Provision should be made so that plywood floors may be quickly installed where necessary. In fact, the rate of floor attrition in cargo use is high and, as a result, where heavy cargo has been transported, replacement may be necessary after 1000 to 2000 hours. Airframe manufacturers conceivably could maintain a stock of plywood-floor panels cut to proper size, and supply these in kit form to the maintenance facilities. Reduction in the reinstallation man-hours would result.

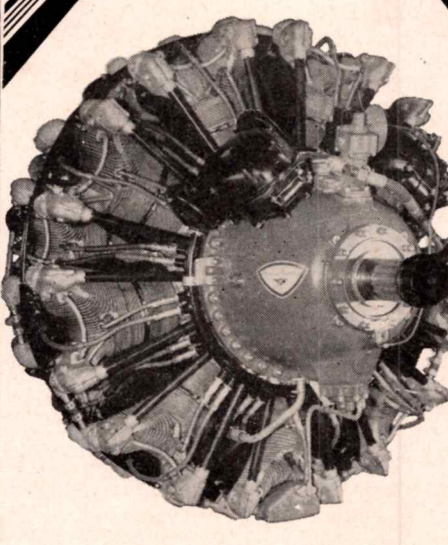
In the flight and crew compartments, a heavier grade of linoleum floor covering also would be advantageous. Considerable wear of this covering occurs in normal service and requires several man-hours to replace it.

The interior hardware on doors, bulkheads, fixtures, for some reason is usually of flimsy construction; door handles frequently require replacement. A better grade of hardware should be installed to afford longer durability.

In the lavatories, because of the inherent corrosion potential, the use of stainless-steel

(Continued on page 100)

COMPLIED WITH



CAA AIRWORTHINESS DIRECTIVE

Modifications and inspections of civil aircraft as described below are mandatory. Aircraft which are not modified and inspected as required herein are considered unairworthy, and continued flight of such aircraft will be regarded as violations of the Civil Air Regulations. For a complete list see previous '449 cards and Airworthiness Directive Summary dated June 1, 1949, issued by the Civil Aeronautics Administration.

**49-42-2
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Applies to all Military R-2800 B series engines installed in Certificated Cessna C-46 aircraft (R-2800-21, -27, -41, -43, -51, -59, -63, -71, -75, -79).

Supercharger impeller thrust bearing failures with resulting complete loss of power have been reported; their failure is believed due principally to sludged oil feed passages. As a precautionary measure, it is recommended that the engine be operated with minimum use of high ratio supercharger and that particular attention be directed toward keeping oil sludge to a minimum and maintaining open oil screens until modifications (a) or (b) below have been accomplished.

(a) Incorporate the 'outside in' lubrication system and modified thrust bearing with improved oil passages as described in American Airmotive Engineering Directive No. 288-1-49. For details of this modification, contact American Airmotive, Miami, Florida. This lubrication system tends to prevent the formation of sludged oil passages.

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ISSUE NO. 49-42

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Private Pilot's Handbook. By A. G. Norwood. 300 pp; illus; appendix; index. \$4.50.—Second edition of a popular book in a series on private and business flying of which Dr. Alexander Klemin is advisory editor. Basically the same clear, competently written text, brought up to date and printed in a crisp, attractive format. The author, a wartime Naval commander, in charge of large training schools, makes the point that, despite all technological advances in aviation, the pilot still flies the airplane.

Mask of Glory. By Dan Levin. 278 pp. \$3.—First novel by a former Marine who served at the Battles of Saipan, Tinian and Iwo Jima. A biting and frequently fiercely tender study of the way man can reach the stars from a beginning in sordidness. Glenn Manson (born Minkiewicz in Cleveland) is taken into the Marines at the age of 19 for World War II, lives, fights, and loves and leaves the Portuguese-Japanese Isabella on the Pacific Island of Akalana. Over and above this simple story of the growth of youth to manhood, a kind of modern puberty rite, is the terrific impact it has in completing the Americanization of a one-time immigrant family. The concept that gave rise to this work approaches genius—but one has to read it all to find it.

The Donnington Legend. By David Beaty. 309 pp. \$3.—Beautifully written war novel concerning the young leader of a group of British airmen stationed on a tiny island near the

Faroes. The tale is told as a succession of papers written by his friends and some not-so-friendly associates, each of whom seeks to explain him. The whole is so adroitly done that even the small, inevitable repetitions advance the vibrant story of Keith Donnington. Characterizations are brilliant. Written by a former ace flyer in the RAF who is now a pilot on the BOAC transatlantic run.

Faraway Fields: the Career of an Airline Publicity Girl. By Patricia O'Malley. 244 pp. \$2.50.—A book for teen-age girls. It presents the operation of an international airways system in terms of a young press agent who is assigned to write a movie concerning it and travels the system to acquire materials. A creditable but routine job by a writer who knows her pedagogy and her aviation. She was on the staff of the President's Air Policy Commission—the Finletter Board.

No Banners, No Bugles. By Edward Ellsberg. 370 pp. \$4.—The author was in direct charge of salvage operations in the Mediterranean when the Allies invaded North Africa in 1942. This is his interesting story of that experience, told with a genuine writing skill that lifts his book far above the ordinary level of war narrations. Ellsberg is already well known as author of other books and numerous feature articles in leading magazines.

Helicopter Engineering. By Raymond A. Young. 255 pp; illus; bibliography; index. \$10.—Young's text fills a need and merits its name. The first three chapters give just the right background of aerodynamics and dynamics, presented not too profoundly but accurately and clearly. The author then deals excellently with fundamental-design consideration and passes on to three chapters on performance, horizontal flight and vertical-flight performance. The chapter on jet-reaction rotor blades is a fine introduction to a subject which will be more and more important in the helicopter field. General theory of stability is somewhat brief, but this is more than compensated for by Part II of the book, which covers rotor-blade design and stress analysis. People seriously interested in helicopter engineering will buy the book no matter what its price.

Wing Scout Manual: For Senior Girl Scouts and Adult Leaders Working on Aviation Programs. 267 pp; illus; index.—Admirable over-all presentation of what aviation is and the opportunities for and place of women in it. A limited number of copies are being distributed to points of special usefulness, with others to be made available later at nominal price. Requests should be sent direct to Program Dept., Girl Scouts of the U.S.A., 155 East 44th Street, New York 17, N. Y.

The Road Ahead: America's Creeping Revolution. By John T. Flynn. 160 pp. \$2.50.—A vigorous answer, by a distinguished American journalist, to the burning question, "Where are we heading—towards communism or fascism?" The author believes that currently we are on the way to socialism which, to his mind, is the fork in the road. Reviewing England's distressing example which lies before us, he believes that there still is time to preserve our free society. He supports this opinion with a wealth of cited facts, and the whole necessarily makes exciting reading. When you put this book down, you are likely to discover that you love your country more than you suspected—and then you will pick this book up again!

The "Bismarck" Episode. By Capt. Russell Grenfell, RN. 219 pp; illus; index. \$3.—Breath-taking story of the hunting down of the huge German battleship, sister ship of the *Tirpitz* and first to be completed for combat. The action covers six days, beginning May 21, 1941, during which the *Bismarck* left her hiding place in a Norwegian fjord near Bergen and proceeded to a position near Brest, where she was sunk by the British. In the interval, the proud British *Hood* was lost with hundreds of lives but with the factor of vengeance now added to the pursuit. Aviation, of course, played its vital part throughout. The account is detailed, thoroughgoing in its research and vividly written.

Cadets at King's Point. By Ray Morse. 250 pp. \$2.50.—For teen-agers on training for officers' rank in the Merchant Marine Academy. A conventional thread of story carries the information pleasantly and with the customary excitement at stated intervals. A creditable piece of writing in its field.

Aircraft Engines of the World, 1949. Paul H. Wilkinson. 324 pp; illus; index. \$11.—This is a new edition of the only international reference book devoted exclusively to the specifications of jet and reciprocating aircraft engines. The highly regarded standardized data pages continue as a special feature of the book. The Jet Engines section comprises 100 pages, tabulating 30 turbojets and 15 turboprops, 20 of which are new. The Reciprocating Engines section contains 192 pages, including 93 complete engine specifications, 21 of them new. Each section is separately indexed. A very useful handbook, authoritative, accurate and highly recommended.

General Kenney Reports: A Personal History of the Pacific War. By General George C. Kenney. Approx. 560 pp; illus. \$4.50.—Throughout World War II, the author who was commanding general of the Allied Air Forces in the Southwest Pacific theatre, kept a detailed diary. Using this as a basis, he has written an earthy, he-man account of how the Japs were driven back from Buna to Honshu, interspersed with lively anecdotes and picturesque descriptions of matters about which every reader would like to know. A first-rate job and a decided acquisition to the library of source materials on "the late unpleasantness" with Japan. Copies first were made available on Nov. 1.

Money-Making Hobbies. 160 pp; illus; index. \$2.—A selection of articles from *Popular Mechanics*, dealing with home manipulation of plastics, leather, wood, ceramics, metal, textiles and fibers, gems, glass, flowers and paper. Imparts much useful basic information in a pleasant manner and incorporates numerous practical suggestions for the amateur craftsman.

Metal Finishing: Guidebook-Directory, 1949. 468 pp. \$2.—The 18th annual issue of a publication important in its special field. The body of contents is divided under the headings: Finishing - Plant Engineering; Abrasive Methods; Cleaning, Pickling, Electroplating; Plating Solutions; Surface Treatments; Control and Testing—and there are supplementary lists of suppliers, manufacturers, schools and societies, together with trade names and titles for a selected reference library.



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Airline Competition. By Frederick W. Gill and Gilbert L. Bates. 704 pp; tables; charts; index. \$5.75.—A scholarly and impartial study under auspices of the Harvard Business School, of the effects of competition on the quality and price of airline service. The effects of competition on the financial status of our airlines are considered also. Part I introduces the problem of airline competition; Parts II, III and IV are concerned with the interests of the traveler; Part V deals with effects of competition on the self-sufficiency of the various airlines and hence their burden to the Government. A book to be read by everyone who is interested seriously in the economics of American air transportation.

Operation Survival. By William H. Hessler. 282 pp; maps; index. \$3.—A brilliant and startlingly up-to-date survey of the factors that necessarily must govern America's unsought and uncomfortable position in world affairs, composed by a well-known writer and radio commentator who served in the Pacific Theater during the past war, as a vice-consul abroad and as a witness to the A-Bomb tests at Bikini. His work is quite unlike most of the other atom-bomb discussions in its constant effort to stress the realistic conditions we face, and he treats of these with gratifying penetration. Naturally, he has much to say concerning the top role to be played by aircraft. A great many persons are going to acquire reputations for knowing what they're talking about as a result of reading this stimulating piece of patriotic writing. We hope that it will have a correspondingly good effect in shaping our international policy.

Technology and International Relations. Edited by William Fielding Ogburn. 202 pp; index. \$4.—A study of the machine age from various aspects as seen by as many competent observers. Actually a series of lectures given during 1948 at the University of Chicago under auspices of the Norman Waitt Harris Memorial Foundation. Editor Ogburn himself wrote the aviation chapter. The text provides much interesting information concerning the progress of technology and presents a group of possibilities for human progress from which the reader is expected to choose for himself. Will the industrialization of a nation, with consequent needs of manpower, raw materials and markets, make it aggressive? Will it increase the population? Will it expand political units? Interpreting these and corresponding questions in realistic terms of the world as it has been and is

the function of the several commentators; and without doubt they thus have provided a book that is stimulating, provocative and a very definite contribution to materials for adult thinking.

Roadcap's Airline Record, 1949. 160 pp; illus. \$7.50.—The 2nd edition of a really useful compilation dealing with American airlines. It gives routes, names, history, managements, revenue traffic statistics, income accounts, payload and income account analyses, balance sheets, capitalizations and financial ratios and historical financial summaries. It compresses much otherwise scattered information for everyday reference and should—as in the case of the first edition — be widely and frequently consulted.

U.S. Navy Airplane Crash Fire Fighting—PB97925. Prepared by Aviation Training Division, DCNO (Air), U.S. Navy, in collaboration with the Bureau of Aeronautics, Public Works Branch. 106 pp; illus. \$2.75.—A complete and valuable description of plane-fire causes and warning, rescue and extinguishment devices, accompanied by straight-from-the-shoulder advice on safeguard preparations and emergency behavior. Printed in large clear type with a wealth of pictures. Obtainable from U.S. Dept. of Commerce, Office of Technical Services, Washington, D.C.

Technical Drawing. By Frederick E. Giesecke, Alva Mitchell and Henry Cecil Spencer. 851 pp; illus; bibliography; index. \$4.50.—Third revised edition of a work extensively used as a class text and technical reference book since its first publication in 1933. Continues to be a complete and authoritative treatment, and should prove its place again as one of the most frequently consulted and best-prized possessions of the engineering draughtsman.

Civil Air Regulations and Reference Guide for Pilots. New Edition, Sept. 1949. 136 pp; illus. \$1.50.—Latest issue of a well known and demonstrably useful compilation of CAA rules and miscellaneous other Government information appertaining to CAA examinations for pilots. The material is as thorough and explicit as formerly, and will be found amply sufficient for the stated purpose.

The Atlantic Pact. By Halford L. Hoskins. 104 pp; index. \$2.50. The full text of the pact, with a careful presentation of its circumstances and implications, by a distinguished student of international affairs. Should prove invaluable to those who wish to acquaint themselves with the pact and to those also who wish merely to follow its development.

The Airplane and Its Engine. By C. H. Chatfield, C. Fayette Taylor and Shatswell Ober. 380 pp; illus; bibliography; index. \$4.50.—The 5th revised edition of a well known and widely used work issued originally in 1928. In addition to its presentation of all important new developments in the field, it retains its clear statement of basic principles and step-by-step description of plane construction and performance. An excellent general text from which the student may proceed intelligently into higher engineering studies.

Strength of Metal Aircraft Elements: Document ANC-5a. Issued by the Subcommittee on Air Force-Navy-Civil Aircraft Design Criteria of the Munitions Board Aircraft Committee. Revised Edition, May, 1949. 109 pp; diagrams; index. \$1.25.—Latest issue of a highly useful concentration of Government standards in an especial field, eliminating for the reader the necessity of referring to different handbooks and bulletins when calculating allowable stresses or minimum strength of typical structures. Obtainable direct from U.S. Superintendent of Documents, Washington 25, D.C.

The Dynamics of Human Relations. By Richard W. Wetherill. 3 vols. together, \$6.95. Vol. I: **How To Succeed With People.** 356 pp. \$2.75. Vol. II: **How to Put Your Ideas Across.** 345 pp. \$2.75. Vol. III: **How to Get Leadership and Influence.** 353 pp. \$2.75.—Easy-reading series of glib talks on personality problems, addressed to the person who wants to get somewhere and be somebody. The author, who manifestly deserves better accounting for than the jacket statement

that he spent 20 years as teacher and educator, has simplified human relationships so as to provide a relatively few routines for meeting any reasonable situations as they arise. In terms of John Smith-worked-for-Tom Brown-and-one-day-he-said, Wetherill's routines are highly persuasive. Even the unambitious man who wishes merely to be himself and scorns currying favor by "putting on an act," finds that the text commands his interest and respect.

Heat Transfer, Vol. I. By Max Jakob. 758 pp; diagrams; index. \$12.—An exhaustive study of an important subject, considered in its three aspects, conduction, convection and radiation. Intended as a graduate and intermediate text, but of undoubted value to practicing engineers. The author is research professor of mechanical engineering at the Illinois Institute of Technology and non-resident professor of heat transfer at Purdue University.

Electric Motor Repair. By Robert Rosenberg. 551 pp; illus; index. \$5.—A practical, non-mathematical treatment of armature winding and motor repair by an instructor at George Westinghouse Vocational High School in New York City, intended for shop guidance of workers who have only elementary knowledge of the subject. By means of an ingenious double fold, the pages open into what are in reality two books, side by side, one containing the wealth of illustrations and the other the text in large, clear type to be read on the bench by a worker standing up. A piece of work that is at once admirably conceived and admirably executed.

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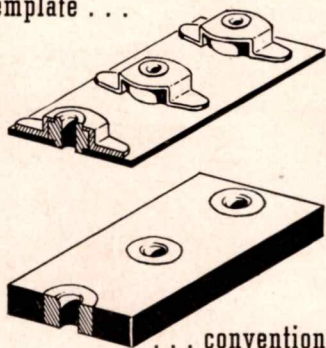
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(Continued from page 97)

baffles around toilet fixtures and urinals is in order. The cost of cleaning and removal of corrosion in the lavatories is a costly item and painting cannot be accomplished well until the corrosion has been removed.

The older the airframe structure becomes, the more severe the CAA requirements. For proper airworthiness, it is necessary to inspect the interior airframe structure to check evidence of failure or corrosion of primary structural members, and also to check the torque of attaching bolts and nuts. To facilitate this inspection, quick removal of the interior soundproofing, insulation, and interior fabric is essential. It is possible that the inclusion of zippers would assist to a reasonable degree.

A permanent holder, preferably of strong plastic, should be provided for the inclusion of the fuel-system diagram. The fuel diagram is a safety item, and it should be kept in an orderly manner in a durable-plastic frame holder, accessible to the pilot in flight.

Provisions for Winterization Modification.—Cargo aircraft fly from one climate to another and from one part of the earth to another. Considerable flying is done in low-temperature areas. At present, the winterization of air transports is a laborious project. Much of this work, however, can be averted by the inclusion of electrical flight instruments, low-temperature resistant hoses, proper low-temperature bearings, ice shields around the control-surface hinges during manufacture.



W. B. Birren

Bill Birren in New Post

William B. Birren has become assistant to the president of Grand Central Airport Co. and Cal-Aero Technical Institute, Glendale, Calif. He had been associated with the Curtiss-Wright organization for over twenty years in the positions of western representative, general sales and service manager, chairman of the board of Caldwell Wright Airport Corp., and president and chairman of the board of Wright Aero, Ltd.

Wing Flaps.—Wing flaps require frequent interior structural repair. To facilitate the repair of ribs and stringers—the cracking of which is caused by exposure to the force of the propeller slipstream during extension—quick-opening inspection-access plates should be provided, wherever possible. They facilitate interior cleaning at engine-change periods or making an inspection if structural repair is necessary.

Fuel and Oil-Tank Filler Neck Caps.—Unless a single-point fueling system is used, fuel-tank filler neck caps should be painted red and permanently placarded as to the number of the tank. Similar action should be taken in relation to the oil-tank filler neck caps, and all should be color coded properly.

Placards.—Placards on the interior of the air transport are subjected to considerable wear and abuse during flight operations and cargo handling. The use of decalcomanias, while satisfactory in certain instances, is not always entirely satisfactory. Placards may be either embossed metal or made of engraved Panelyte plastic, suitable where extensive wear may occur. During overhaul operations, it is necessary frequently to renew decalcomania, and placards which, although comparatively inexpensive, may not always be available in duplicate form. Therefore, durable placards are to be preferred.

Weight Versus Maintenance Costs.—Considerable technical data has been presented to show the advantages of light structural weight in relation to the operation cost. For every pound of excess structural weight saved, each airline places a premium on it for the savings in operational cost. But, in the case of an air-cargo transport, is this always the soundest policy? For example, certain component parts of the airframe and functional system are made of lightweight aluminum alloys, which have somewhat limited durability. In periods of engine change or at overhaul, many parts such as these must be replaced.

Upon analysis, it may be found that the hidden factor of longevity of usage is not being developed and that frequent replacement throughout the life of the cargo transport more than offsets the cost saved in flight operation. Therefore, while a slight increase in weight may necessitate a somewhat higher operational cost per unit, a lower replacement cost should be attained. The comparison of the two cost factors should decide the matter. Parts falling within this weight category are, to mention a few, engine-nacelle parts, engine cowls, inspection-access plates, flooring, door sills, doors and door hardware.

Modification Costs.—While it is acknowledged that many air-cargo operators have different requirements for their interior configuration and a general variance in their ideas of operation, one point should be remembered. That is that any kind of modification which must be done after the airplane has been in service represents a costly outlay on the part of the operator. It is therefore expedient that a proper technical specification program based on operating experience shall be presented to the airframe manufacturers before new equipment is procured.

TALE OF A TURBOJET

(Continued from page 41)

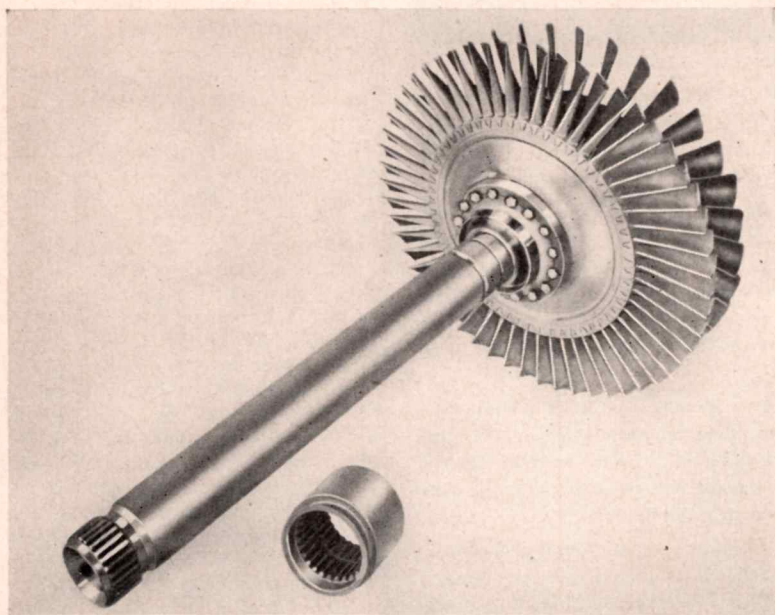


Fig. 5.—Two-stage turbine supplies mechanical power for driving compressor rotor and engine-driven accessories

cooler. The flanges on both ends of the cooler are machined from aluminum castings.

The oil cooler is bolted to the front flange of a cast-magnesium inlet-bearing support. This casting has an inner and an outer cylindrical shell connected by four radial struts. The primary functions of this part are to support the front end of the axial-flow compressor and to provide a front mounting-support point. Additional

functions are to carry a starter on the front side of the inner cylinder and to provide a radial shaft, through the bottom strut, which transmits power to the gearbox mounted on the bottom of this inlet-support casting.

The axial-flow compressor has eleven stages, as can be seen in fig 2. The rotating element consists of a ten-stage aluminum spindle to which is bolted a single steel disc for the eleventh stage. The ro-

PERFORMANCE DATA AND SPECIFICATIONS J34-WE22 24C4B

Compressor:

Axial-flow type, made up of eleven stages. The compressor housing or stator section is made of aluminum alloy

Combustion Chamber:

Stainless steel, consisting of a casing and a double annular perforated stainless-steel liner. Fuel is injected downstream into the combustor by fuel-spray nozzles on the outer and inner annulus

Turbine:

Two stage axial-flow type, with discs of high-temperature nickel-steel alloy and blades of stellite. The stationary nozzle vanes in the turbine section are cast vitallium

Exhaust Collector:

Outer casing is fabricated stainless steel with an inner cone

Starting System:

A direct-drive Westinghouse Electric starter, 2 Bendix ignition coils and two ignitor spark plugs

Lubrication and Bearings:

Three-bearing dry-sump system using solid-oil lubrication. A Nichols 6-unit

gear-pump with one pressure unit and five scavenger units provides the pressure at 80 psi. The system contains a filter purulator, and oil cooling is obtained by circulation through a cylindrical cooler mounted on the front end of the No. 1 Bearing Support

Fuel System:

Holley pump-and-governor combination and an emergency fuel pump. Fuel is supplied to manifold in two concentric fuel rings located at the forward end of the combustion chamber. Harsch nozzles are used for the fuel injection and an automatic Westinghouse dump valve drains the system on shutdown. The engine uses gasoline, AN-F-48, as a fuel

Dimensions and Weight:

Basic Diameter	24 in
Frontal Area	3.2 sq ft
Length	120 in
Weight	1200 lbs

Rating and Performance:

Military Static	3000 lbs thrust
Normal Static	2290 lbs thrust
Intake air speed	250 mph
Exhaust air speed	1200 mph
Turbine blade speed	12,500 mph

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-18	.5616
-20	.6240

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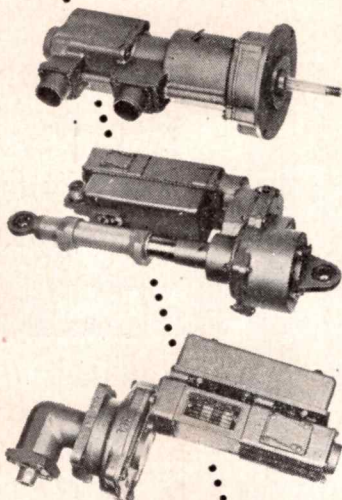
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- This actuator was designed by Hoover to withstand the severe loads encountered during in-flight adjustment of the horizontal stabilizer of a jet fighter. The actuator weighs only 12.5 pounds, yet will withstand an ultimate load of 15,000 pounds without failure.
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tating blades, made of 12% chrome steel, are retained in the outer periphery of the discs by means of a unique bent-wire arrangement. The wire has a tight U-shaped bend at its center that fits into a drilled hole in the spindle groove, thus preventing the wire from moving. After the blade is slid in over the wire, the ends are bent up against the ends of the blade root, locking the blade in position.

The stationary compressor parts include steel-fabricated diaphragms made in halves and assembled in machined grooves in cast-aluminum housings. The diaphragms are retained in place by radial screws coming through drilled holes in the cast housings.

An important feature of the J34 engine is the double annular combustion chamber shown in fig. 3. Air from the compressor first passes into the diffuser, a stainless-steel fabrication, where it is divided into three annular streams. The air then flows radially through both walls of both annular spaces that comprise the combustion area. By proper arrangement of the holes in the double annular liner, it is possible to achieve excellent combustion and stability over a wide range of pressure and velocity conditions. The liner itself is made of high chrome-nickel stainless-steel.

Designed for Durability

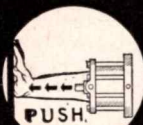
This design of combustion liner has been exceptionally good from a life standpoint. The feature that probably contributes most to this long life is the step-type construction. The walls of the two annuli are made up of cylindrical pieces of different diameters displaced axially from each other and connected by a corrugated strip. Air passing through the openings of the corrugations lays a cooling blanket on the cylindrical liner wall inside the combustion area. This cooling blanket greatly increases the ability of the metal in the basket liner to withstand the high temperatures encountered locally in the combustion area. The combustion liner shown in fig. 4 is one that has passed through a 150-hour test.

Mechanical power for driving the compressor rotor and the engine-driven accessories is supplied from a two-stage turbine such as is shown in fig. 5. The turbine rotor is made up of a steel shaft and two high-temperature alloy-steel discs accurately fitted and bolted together. The shaft extends through the center of the combustion chamber and is bolted to the end of the compressor rotor. The high-temperature alloy turbine blades are locked in grooves broached in the periphery of the discs.

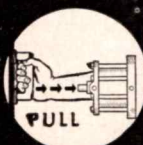
Careful design of the rotating turbine blades and close control of the temperature of the gases reaching them are essential to satisfactory engine operation. In cases of overheating, the first-stage rotating blades will be the first to show the effect of the abuse.

Already, many thousands of hours have been accumulated in field operation of the J34 engine. Because of the new problems encountered in field operation, development work on these engines is still continuing. Already the J34 has been operated successfully at altitudes and at flight speeds well beyond its original design objectives.

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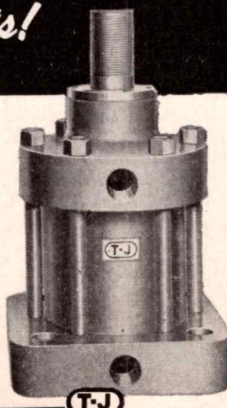


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OFFSHORE RESCUE

(Continued from page 70)

"Duck," which was developed for World War II. Recently the Air Sea Rescue Branch of the U. S. Coast Guard at Bennett Field, in cooperation with the Flight Safety Foundation, conducted tests to determine the efficiency of this vehicle for offshore rescue at night when conditions presumably are more severe than during the day. The demonstration was witnessed by a large group of participants in the Air Transport Safety Seminar conducted by the Flight Safety Foundation.

The Amphibious Duck has the following specifications:

Length	31 ft
Beam	8 ft 2 in
Height	9 ft 2 1/4 in
Displacement	15,000 lbs
Maximum pay load	5,000 lbs
Powerplant	GMC 105-hp, 6-cylinder, air-cooled gasoline-truck engine
Top speed (land)	45 mph
Top speed (water)	6.5 mph

It is believed that many hundreds of these are available from War Surplus at a cost in the neighborhood of \$1000 apiece.

The *Duck* was supplied with several large life rafts, a number of small ones, buoys, several Aldis lights operating from a battery, a "walkie-talkie" radio, and other equipment, such as axes, which would be used to cut into the side of an airplane. The crew would normally consist of about four or five men. Immersion suits were available for crew members who would have to jump overboard to assist in rescuing survivors.

Waterproof lights were attached to the rafts and other buoyant equipment—small marine flashlights which are now obtainable at War Surplus stores for about 20 cents would do. The purpose of the lights was to show the location of the rafts to survivors who might otherwise not see them at night. The *Duck* was painted white to increase its visibility.

The theory of operation is that, when the alarm sounds, the same crew that mans the crash-fire trucks will dash out to the periphery of the airport in the duck and then down a ramp and into the water to provide survivors with rescue facilities.

How It Works

Upon arriving in the vicinity of the crash, the crew would throw out a large number of small buoyant rafts (with lights attached). The swimmers would sight the light, swim to the buoyant equipment and hang on until such time as they are picked up by the *Duck* and other boats. The important objective is to get rescue equipment to survivors in the least time consistent with funds available to provide the service. The *Duck* would carry respiratory equipment and other items needed after survivors are picked up.

The demonstration at Bennett Field took place in darkness. The *Duck* carried a crew of four and approximately a dozen observers. Six dark-colored life vests had been thrown into the water previously about two hundred yards offshort to simulate the heads of survivors.

The *Duck* propelled itself down the ramp and through the water to this point, and dur-

ing the process of picking up the six bobbing vests, also threw out a number of life rafts and other buoyant equipment. Five of the vests were picked up in short order, but it took a little time to find the sixth. The problem of discerning bobbing heads in a choppy sea at night is one that cannot be solved easily except through further tests.

Flares

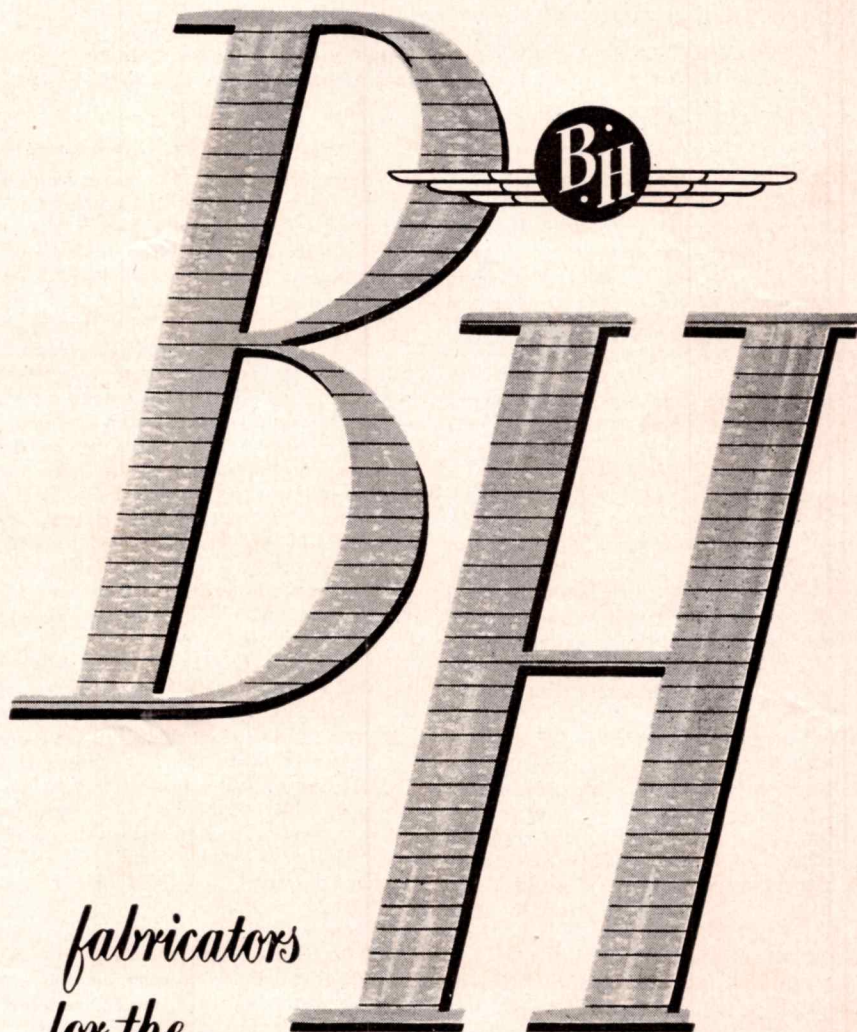
Flares should not be used to illuminate this rescue operation because they might ignite gasoline, or if dropped from aircraft, might fall on nearby property and set it on fire. It is to be remembered also that flares and other pyrotechnics have a critical life which requires constant check and rigid specifications. The Aldis lights were surprisingly effective in illuminating the surface of the water, but it is believed that

further development for night illumination is desirable.

Many airports have borders so soft that the *Duck* might sink in the mud before it could reach the water. In most cases, it would be necessary to build several ramps down which the *Duck* could enter the water. These ramps should be fairly wide to allow for drift due to wind or current.

Probably the cheapest way to build these ramps is to dump a layer of crushed stone and cover it with steel mesh of the type used during the war for runways. Increased flotation might be achieved by placing large logs in the mud under the stone.

The *Duck* accomplished its mission in about 20 minutes and demonstrated that this system is effective and should be within easy economic range of any airport which has a crash-fire rescue crew.



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HELICOPTER AFTER DARK

(Continued from page 53)



A "Hiller 360" helicopter flying over San Francisco Bay completely unaided. Flight observers are seated at sides of engine. A 25-mile flight was made at 3800 ft, the success of which is attributed to the Hiller "Rotor-Matic" system stability. This is reported to be the first pilotless cross-country helicopter flight

Hovering.—A landing light fixed to throw its beam down 30° from the horizontal provides an adequately lighted area immediately in front of the machine. There is a tendency to drift while hovering, and the pilot should give special attention to proper fuselage attitude.

Takeoffs.—Takeoffs can be made in normal manner from hover, but altitude is more important than airspeed. Climbs from low altitudes should be made at best rate of climb airspeed, say 45 mph, IAS.

Approaches.—They can be normal, but last 100 ft should be flown at reduced airspeed and rate of descent to avoid sudden, major control corrections. Landing light should be used only during the latter portion of the approach. Premature lighting (about 300 ft) will result in a white hazy cone of light that is distracting and reduces forward vision.

Emergency Operations.—Familiarity with terrain is essential. Normal daytime emergency procedure may be followed, supplemented by use of landing light. Pilot should limit steepness of his cyclic flare since he will lose ground reference once he has flared beyond the range or inclination angle of the light. Some suggestions are: (a) caution should be used in side-ward or backward flight; (b) altimeter should be zeroed for local-area flights; (c) sufficient altitude to clear obstructions in cross-country flights; (d) cockpit instrument-panel light should be kept at low output; (e) lighting system, position lights and instrument-panel lights should be checked before takeoff. Lights on horizon are deceptive as an indication of distance and relative motion; (f) no two lights which apparently are lined up with your flight path should be used as altitude and drift references; (g) low-altitude flight over level terrain can be accomplished best by "panning" with the landing light,

making mild S-turns and sending the beam back and forth, giving the pilot the complete picture of obstacles in a wide area in front of him.

Engine Failure (47D-S with Floats).—Make a normal autorotative descent at approximately 34 mph. At 100 ft or less, dependent upon water surface, establish a slightly nose-high attitude, such that a slow rate of deceleration will be assured to provide an airspeed of 15-20 mph at time of water contact. At approximately 50 ft, increase main-rotor pitch slowly and smoothly with no change in fuselage attitude, so water contact is made with little or no vertical velocity. After water contact is made, maintain a "planing" attitude to prevent float bows from "nosing under" until forward speed is reduced to 0.

Overland Flight.—Altitude should be 300-500 ft, depending on surface and ground reference. It is desirable at all times during night flight to have ground reference other than that provided by landing light. Altitude for flight over open water should be 100 ft, except under dead-calm conditions, when a suitable lower altitude should be selected by the pilot and landing-light beam should be raised.

And what is the night-flying equipment on the Bell helicopters? The kit includes a landing light, adjustable on the ground, eight instrument-panel lights, suitable wiring, circuit breakers and switches. The normal angle of adjustable light on the 47D-S (float model) is 12°, as measured from the axis of light to centerline of the float tube. Is it possible to use night-flying equipment in combination with dusting or spray equipment? Yes, provided the night-flying equipment also includes a 25-amp generator kit. This is welcome news to crop-spraying operators.

How Los Angeles Airways Does It

Julius Caesar could conquer and write up his achievements snappily, and so can Clar-

ence Belinn, President of LAA. It is a pleasure to read his remarks on helicopter night flying.

Belinn and his associates have devised a special collective-pitch stick for their Sikorsky S-51's, now equipped with landing lights. The pilot's hands are always well occupied in landing and takeoffs. To care for light switches is an added chore. The LAA men lessened the pilot's task by providing a collective-pitch stick that combined five functions:

- (1) Control of Collective pitch
- (2) Engine throttle control
- (3) Left landing light
- (4) Right landing light
- (5) Loading light for mail

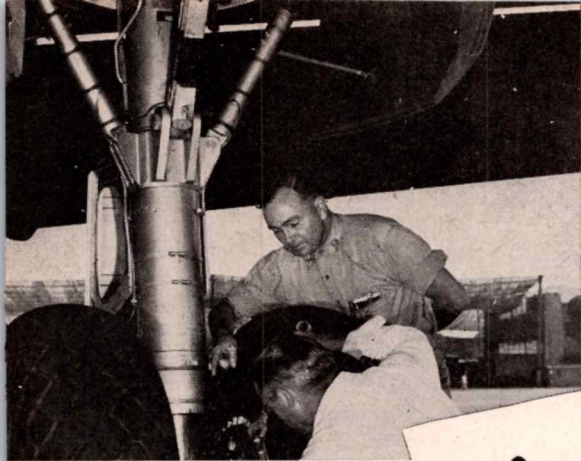
The landing lights gave LAA technicians no trouble because they found they could use two conventional aircraft landing lights. Contrary to Sikorsky recommendations, both were installed in the nose of the helicopter. One is a flood light which illuminates a wide patch of ground and outlines the heliport. The other light pin-points the spot on which the helicopter will touch down.

The real difficulty is in lighting the heliports themselves. Belinn and his associates went into huddles with CAA experts and with builders of various boundary lights. They made many flight tests and found that desirable lights cost too much and would take too long to install. They also ran up against three other obstacles:

- (1). To comply with the myriad standard lighting requirements of many municipalities is prohibitive in time and expense
- (2). Bringing power lines into heliports means an additional hazard in powers and line
- (3). To invest in standard lighting systems means that flexibility of operation is sacrificed. A helicopter service should be able to shift or abandon bases rapidly and at will.

In the light of all these difficulties, they finally decided to make a new approach—and finally found a simple solution. Co-operating with the Minnesota Mining Co. and the CAA, Los Angeles Airways technicians developed a special reflector, consisting of a small sheet of *Scotch-light* glued to a piece of *masonite*. They fastened these reflecting sheets to both sides of the heliport fenceposts, so that the area for landing was outlined exactly by the glow picked up from the lights of the incoming helicopter.

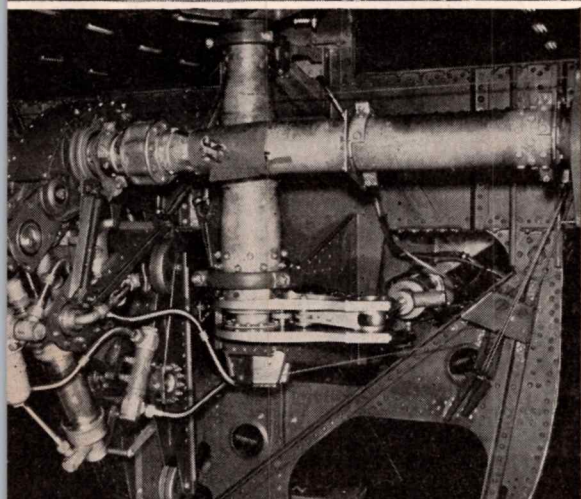
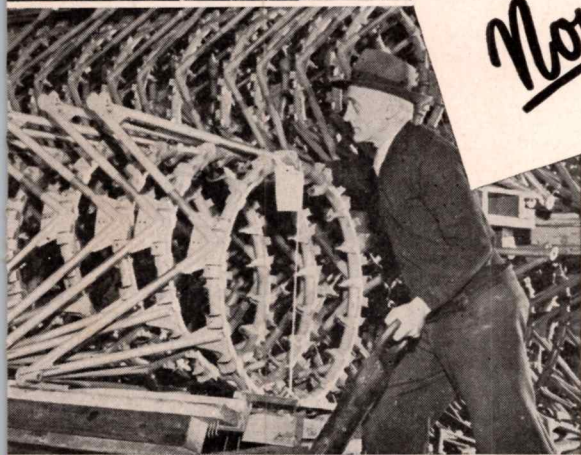
This still left the pilot with the problem of locating the heliport from the air. LAA experimented with all kinds of beacons, spotlights, blinkers, etc. Finally they got the bright idea of using an ordinary high-intensity railroad signal fuse. The postal messengers who connect the heliport with the various Post Offices in the Los Angeles area are supplied with these flares. Just a few minutes before the arrival time of the flight, the messenger lights the fuse and sticks one end of the flare into a sand barrel located next to the gate of a heliport. The light is very distinct, and the pilots see it for miles. The railroad fuse proved to be the missing link, and Sikorsky S-51's are now flying as com-



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U N I T E D S T A T E S S T E E L

fortably in dusk or dark as they do at mid-day.

The British, too, are making night-flying experiments. Wing Commander R. A. C. Brie is in charge of the British European Airways (BEAC) Helicopter Unit. With five good pilots, three Sikorsky S-51's and two Bells at his disposal, Commander Brie has conducted an experimental night mail service, by helicopter, carrying dummy mail in the windy and rainy regions of East England, between Peterborough and Norwich, for a period of one month.

He concludes that a scheduled service can be flown with great regularity by day or night, and without the use of expensive equipment, large handling crews or elaborate "rotor stations." This is fine news and confirms what Los Angeles Airways has found.

Besides, there was an interesting by-product of these experiments, a helicopter night-landing unit as shown in a sketch on the opening page (based on a story in *Flight*). This is a combined floodlight and wind indicator, strikingly called the

Wiggimac to honor its inventors, Wigdortchick and McClements. The *Wiggimac* is equipped with GE low-intensity approach-light fitting mounted 3 ft 6 in above the ground. A 250-watt projector lamp has been modified to give its peak intensity at 2½° below the horizontal. A conical screw cuts off the light at 3° above the horizontal. There is an obstruction light above the unit, and a vertical shadow bar is mounted at the end of the wind-indicator. Here is what this unit accomplishes:

- (1) It produces a 100 ft circle of light of uniform illumination
- (2) Because the vertical bar produces a well-defined shadow, the pilot can tell the wind direction from a distance of about 1000 ft
- (3) Flying in darkness (but not in fog), the pilot can appreciate the texture of the ground from a great-enough height to make a good touchdown.

Would it be worth trying out a similar inexpensive gadget in our own flying operations?

LEGISLATION PASSED AND PENDING

(Continued from page 34)

- 366 Radio lab, U. S. Bureau of Standards, authorize
 - 378 Raise duty exemption on imports from \$400 to \$500
 - **382 Federal airports, apportionment of funds
 - 386 Guided-missile lab, U. S. Bureau of Standards, authorize
 - 390 Alaskan supplies, Department of Commerce
 - *393 Minimum wage 75c per hour, Fair Labor Standards Act, exempt air carriers under Railway Labor Act
 - 404 Federal airports, Virgin Islands
 - 414 Alaskan communications stations, authorize buildings
 - **415 Air-engineering center and wind tunnels, Air Force, authorize
 - 420 Military installations, including Alaska and Okinawa
 - 422 Atomic-production facilities, expedite construction
 - 424 Army Quartermaster research lab, authorize
- These were the legislative bills. Also there was one Private Law, No. 297. It authorized Paul A. Smith to serve as U. S. representative on ICAO.

Appropriations

All told, aviation received close to \$5½ billion in direct appropriations, plus financing of collateral activity and several hundred millions in new contract authority. The total looks big compared with prior years because items previously carried under Army budgets have been transferred to the Air Force, as its separation is complete.

The Air Force, after building as far as 59 groups toward the 70-group goal, was held to 48. Though the House held firm for its 58-group appropriation, the Senate concurred, apparently with the idea that the White

House would withhold the extra money.

The exact total for procurement has not been settled finally as this is written; the program for fiscal 1950 has been delayed five months, since the fiscal year began July 1. Neither is it known how much aviation equipment will figure in the military aid to Europe.

Following are Public Law numbers of appropriation bills which contain aviation items: 71, 1st Deficiency; 119, 2nd Deficiency; 150, Treasury-Post Office; 179, State-Justice-Commerce (including CAA and CAB); 266, Independent Offices (including NACA and VA); 327, Foreign Aid; 343, 3rd Deficiency; 358, 1st Supplemental; 430, 2nd Supplemental; and **434, Military.

Note also that Public Laws, 30, 60 and 415, among others, authorize funds for the start of large Air Force programs.

Copies of public laws may be ordered from Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 5c each, or a little more for those of more than a few pages.

Other Action Completed

One bill was vetoed—HR 5508, for Armed Services retirement benefits. A bill for stockpiling of critical ores, metals, and minerals, S 2105, failed in the House.

Of continuing effect through 1950 are several resolutions authorizing investigations. **S Res 50 is for the definitive airline study by the Senate

Committee on Interstate and Foreign Commerce.

For the House Interstate Committee, H Res 107 and 157 give routine authority for investigations. Likewise, H Res 114 and 115 authorize studies by the Post Office Committee. H Res 238 provides for an immigration study, of airline-passenger interest, by the Judiciary Committee.

**H Res 234 and 242 set off the House Armed Services Committee probe of the B-36 and related matters.

The Senate adopted S Res 172 favoring development of a plane for farm use by CAA and the Department of Agriculture.

Nearly Through

Next session, all incompleting bills retain the status they had reached at the adjournment of the first session and can proceed from there.

**HR 1437, to define the composition of the Army and Air Force is the most important holdover. The original House version gave authority for a 70-group Air Force. Although this was merely on paper without appropriations to man and arm the groups, almost unanimous House passage was hailed as an important expression of policy.

The Senate, however, heeded the Budget Bureau and merely authorized up to 24,000 serviceable aircraft, or as many less as future Congresses might care to finance, with procurement also at the will of the budgeteers rather than by statutory quota.

A good point about the Senate draft was that, for all three Services, funds for purchase and development of "technical weapons"—which should include aircraft—would be available until spent. This would help in long-range planning of procurement and research.

A ban, however, was inserted by the Senate against development or purchase by military funds of commercial-type aircraft, even if of some military convertibility. This would seem to prohibit further purchase of some of the present transport and training planes bought by the Services, if enacted in this form. The Senate and House conferees, however, failed to reach agreement before the session adjourned.

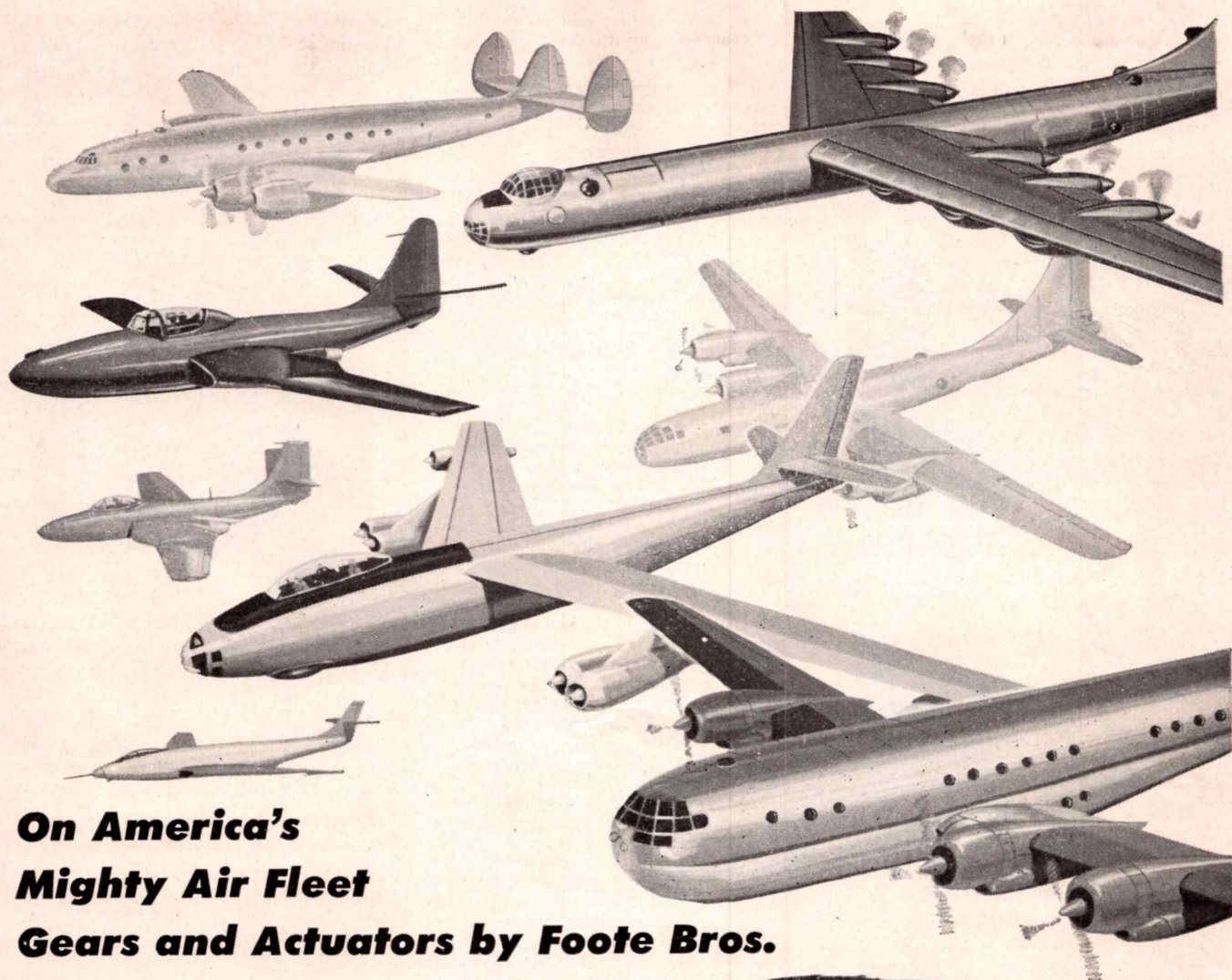
Halfway Through

Several bills jumped the first hurdle of passage by the house of origin but failed to complete the second one.

S 4 would give advanced air training to CAA technical personnel

S 247, National Science Foundation. The companion bill, HR 4846, was reported favorably by House Committee for floor action

*S 249, Taft-Hartley Act repeal. HR



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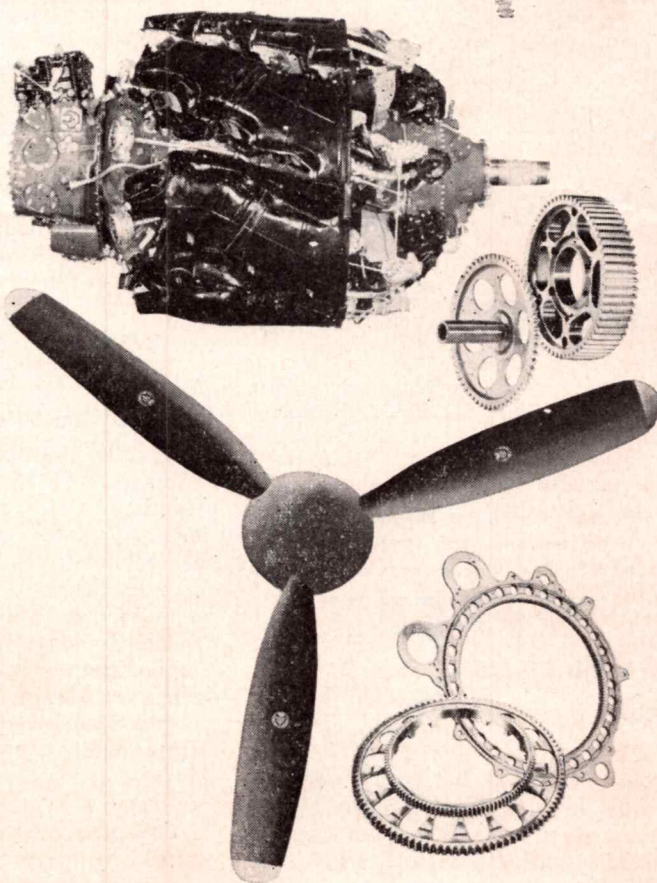
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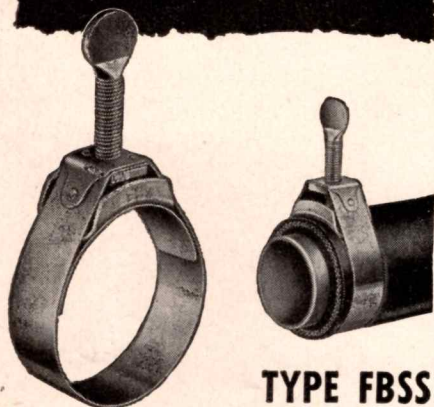


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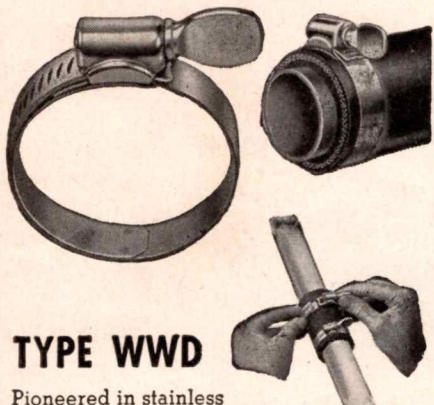
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2032, the companion bill, was recommitted in the House

- S 442, animal and plant quarantine, apply to air
- **S 450, delegation of powers by Civil Aeronautics Administrator; is opposed by airline pilots
- S 1282, Federal Airport Act, minor projects at major airports, reported in House
- S 1283, Interior Department airports, to be built in National Parks, reported in House
- S 2380, Dental care, Army and Air Force
- S 2436, Alaskan airport, reported in House
- *S 2596, Veterans schools, reported in House. An amendment in the Independent Offices supply bill, Public Law 266, liberalized the GI flight proviso so veterans could demand flight courses by affidavit, accompanied by two corroborating affidavits, stating that the training would help their careers. Language added in conference, however, imposed new regulations on private schools generally. The Veterans Administration made highly restrictive interpretations on the proviso that only schools in operation over a year be eligible; also on rights of veterans to take additional courses after having started training. The new bill is to define veterans' rights, still with safeguards against waste of funds in avocational and recreational courses
- *HR 3905, is a routine tax bill with a Senate rider, as reported from Senate Finance Committee, to reduce the tax on travel from 15% to 10%. Airlines want to remove this tax, and the tax on freight, altogether
- HR 3946, for training of NACA technical personnel, is on Senate Calendar, as is the companion bill, S 1393
- HR 4082, is to assign certain CAB functions to employees
- HR 5368, real-property transfers, Army and Air Force
- HJR 21, history of aviation in unfinished Capitol frieze

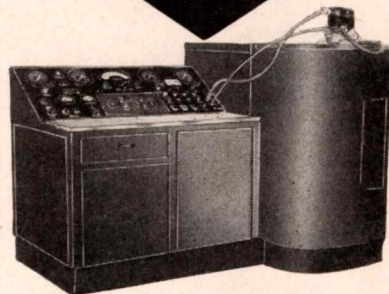
Other Bills Pending

Reported from committee for Senate action are **S 12, to require that international air agreements be by Senate-approved treaty (opposed by the administration), and —*S 1946 for a National Commission on Inter-governmental Relations.

Dozens of aviation bills remain in the committees where they were referred originally on introduction. Important subjects in this category affecting aviation include the U. S. Air Academy, approved by the Defense Secretary.

Airplane-prototype legislation is spurred by the progress of British jet

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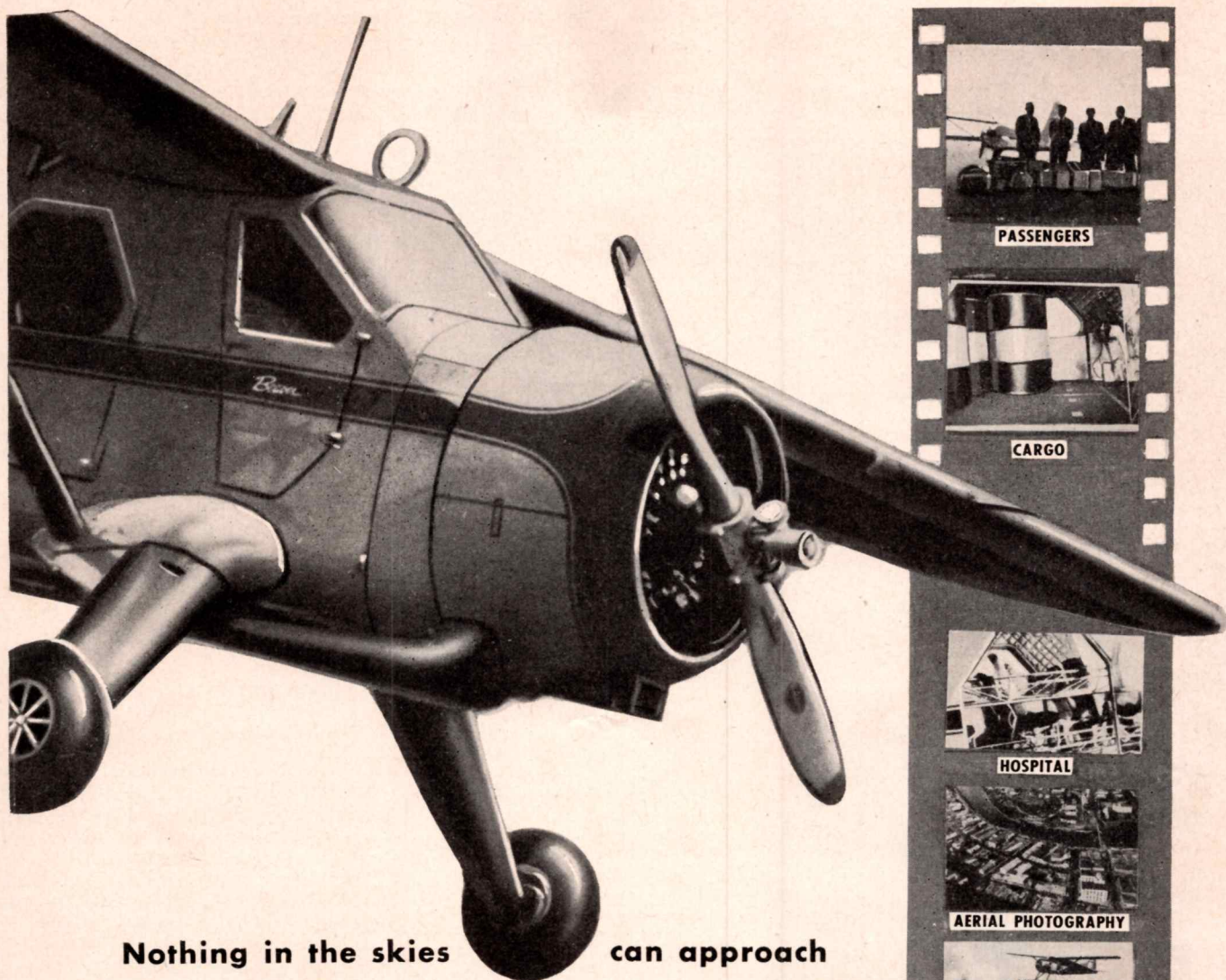
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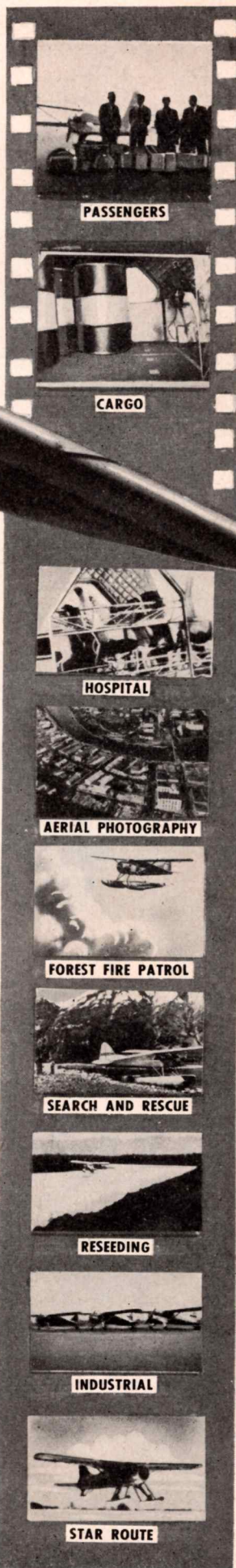
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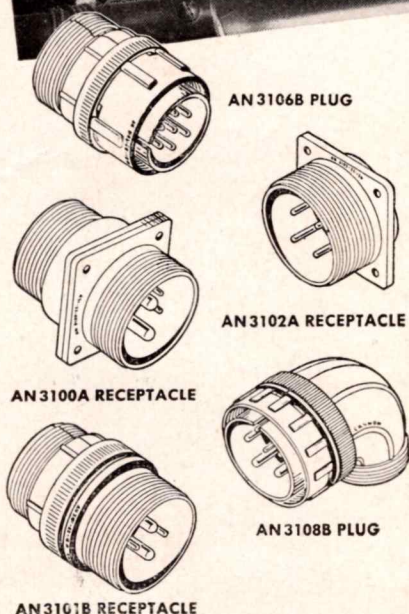
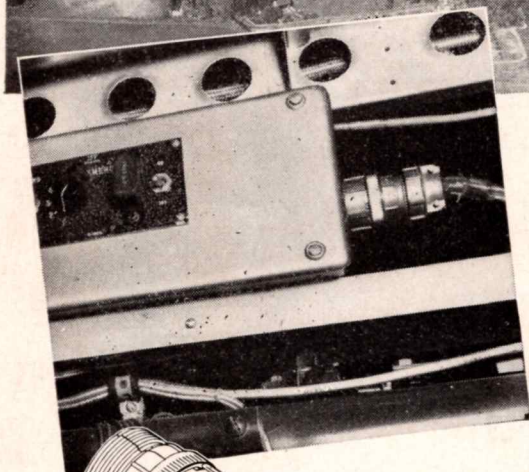
Chase uses Cannon Plugs



Twin engine assault transport, C-122, made by Chase Aircraft of West Trenton, New Jersey. A new medium short range, high performance transport designed for the Air Force by Michael Stroukoff, Chase's Chief Engineer, for tactical use of cargo and personnel. Cruise speed reported as 200 mph with 13,000 lb. load.

★

At the left are Cannon Electric AN3106B Plug and AN3057 Cable Clamp on the radio control panel of the C-122.



EVERY large airplane of American make today uses many different types, sizes and combinations of Cannon Plugs. When the large commercial and military aircraft in the middle thirties came off the production lines the first multi-contact quick-disconnect plugs were Cannon made. Since that time Cannon Plugs have continued to maintain the leadership in their fields of design, engineering and manufacturing, with the largest plant and production facilities for electric connectors in the world. For an introduction to Cannon Plugs, write for the new C-48 Catalog.

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development.

On separation of air-mail pay from subsidy, there is pressure from several quarters. Senate Appropriations Committee is waiting for Senate Interstate investigation but wants the change made.

Regulation of contract carriers and reestablishment of an independent safety board are among pending civil-air items. The bill for improvement of undeveloped areas of the world, HR 5615, on which House hearings were held, may open air-transport opportunities.

Industry wants repeal of Vinson-Trammell profit limitations; also a peacetime contract settlement act, for which a Defense Department draft is awaited.

Much remains to be done. For copies of bills and resolutions, write your Congressman or Senator. You may, at the same time, put in a plug for air power.

SO WE'VE GOT IT

(Continued from page 23)

they have a year and a half, maybe two years, of perfection of those jobs before they are ready for line operation, and then there is a year or two years before they will really get into production on them.

Then you mustn't forget that if they are any good they are going to keep the first ones themselves. That is A-B-C.

In the interim, if we go into this picture realistically with our manufacturers and with our engineers and operators, I believe frankly that the American manufacturers and operators will have a better job sooner than the British, in so far as economic airline operation is concerned, and that means, in my opinion, anywhere from five to seven years. Which brings up the question of whether or not the turboprop job is the ideal one for short haul. Frankly, I don't know. I do know what the engineers say and think about it.

Sure we know that the turboprop is more efficient than a straight jet for short hauls. Maybe that is the answer—but I question it with the rapid development that is being made in two fundamentals in jet propulsion.

Number one—reliability. Take the Allison gas turbine. They are getting 500 hours between overhauls, and it was just yesterday that we were getting only that out of a reciprocating engine. So that item is progressing rapidly. I know that the British already have asked for a certification of 600 hours between overhauls on one of their jobs, which means that the reliability end of it is being taken care of.

Number two is fuel consumption. That, in itself, is a vital problem; and yet, maybe by the time that a turboprop transport could be perfected, the need for it would have disappeared. That has happened in our business many, many times.

I am inclined to think that, within five, six or seven years, the economy of the jet engine will be such that a prop won't be

necessary. We will find ways and means of utilizing and developing the economics in a manner that will be cheaper for us to eliminate the prop, its gear box and all the contraptions that go with it.

Now, you might say, "What would you do, Eddie, if someone gave you the ideal airplane today—a jet job?" They would have to *give* it to me, to start with. In the second place, they would have to pay for all the work I did on it in trying to perfect it for them, in spite of its perfection, because there never has been one made like that. I never yet have seen an airplane that was any good as an air-transport plane short of two years of operation on the airlines. It has a deadline, the same as a newspaper. The airline deadline is departure—arriving on time and departing on time.

A new transport is put on the line with 25, 30, 40, 50 or 60 ticketholders waiting, with bag and baggage—and they have made dates at their destination. Not until the airplane is at the terminal, at the gate waiting to load the passengers (and then something goes wrong and you have to cancel the flight or delay it an hour or two or three), have you found out the real value of the unit that you are using, or the cost of the lack of perfection that exists in it.

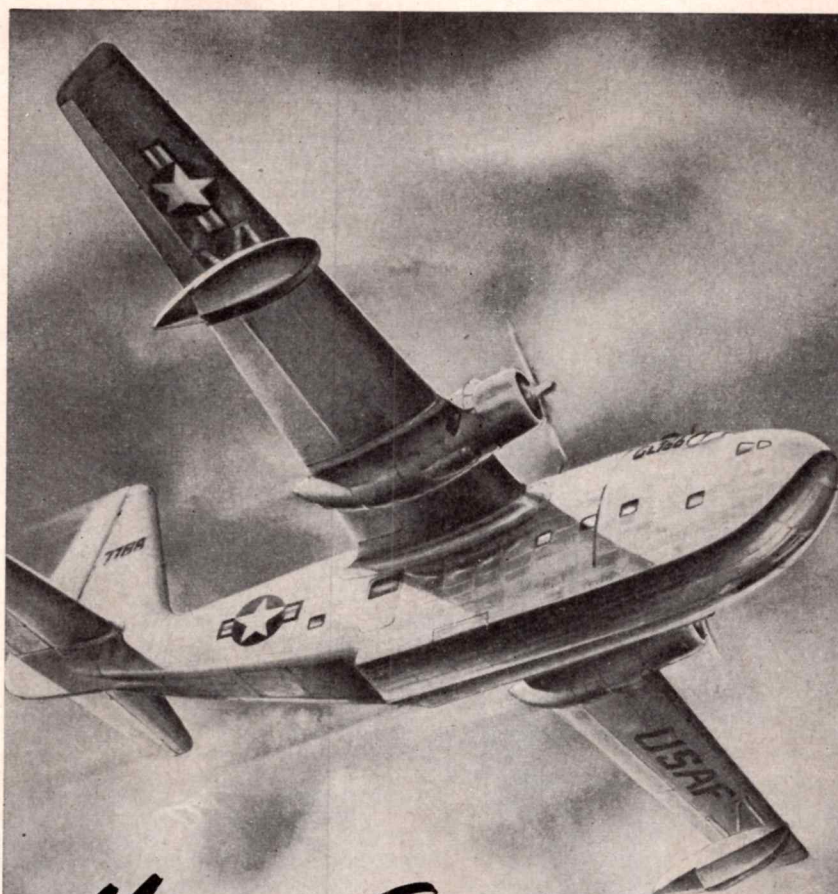
Conditions

So, I would say that I would use your airplane, Mr. Manufacturer, if you pay the operation costs. I will use it for six months or a year. I will put it on the line. I will operate it as I know it must be operated to be of service to my company, the stockholders and to the public that we try to serve. And you will get the cheapest kind of experience that I know of for the lowest cost, because you can test them and test them and test them at the factory, at the airports, any place you want to mention, and you will not under any circumstances get the facts until you put the deadline on them and put them on schedule. All of which means that there is still another angle to this development of jet-propulsion.

As for the smaller units, there are several manufacturers that can afford to build them, maybe spend five or six millions to perfect one. However, the larger units, designed to carry 60, 70, 80 or 100 passengers, require 25, 35, or 40 million dollars worth of development cost, and there is no manufacturer or airline—in fact, no combination of airlines—that has that kind of money. Therefore, it falls back on the taxpayer's pocket, meaning that the Government must develop the prototype and we all pay for it—although I have not seen anything yet which the Government developed that was worth much as far as its commercial use was concerned.

The Government should appropriate a sum of 75 to 100 million dollars and give a set of specifications to larger manufacturers. I could simplify mine by saying: "I want an airplane that will do 500 miles an hour, that will have a range of 2500 miles and carry 60 passengers, or a 3500-mile range and carry 45 to 50 passengers, and it should not cost over one million dollars, in order to get the capital investment down to where airlines can afford to buy it."

That would be an ideal job, in my opinion, for transcontinental work and for the majority of the larger lines within our boun-



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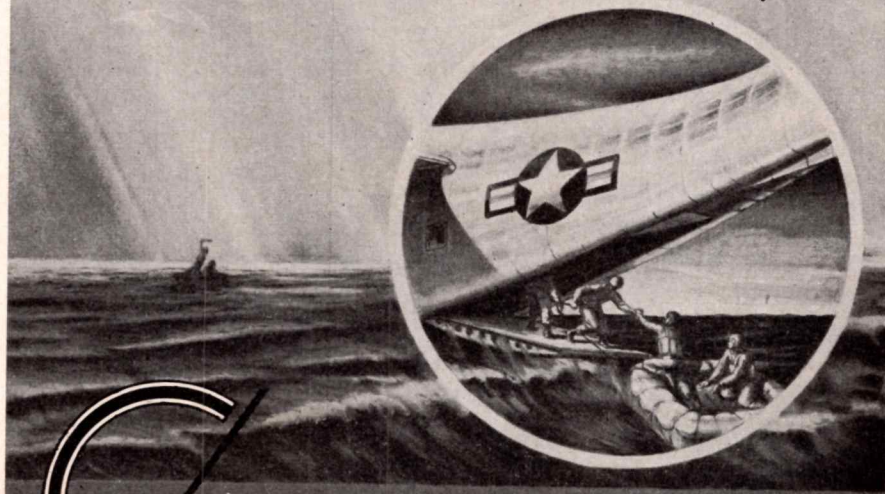
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daries. It would also fit some of the international schedules. It would even take care of most of the North Atlantic runs and would certainly take care of the Western Hemisphere.

But, when you talk to these manufacturers, they start talking in terms of three million dollars per airplane. Sure, I know that at 500 or 600 miles per hour it is going to take only one airplane to do the work of two of the ordinary; but that is no reason why they should charge you twice the price

—because you cannot get a corresponding income from the public.

So much for what I don't know about the jet, and that's a lot. I will continue to follow my practice of the past and try to be realistic and practical in my assumptions and decisions. If everybody else will do the same, we will make a lot of headway in this business, and we won't need to worry about the British or anybody else, in so far as progress is concerned during the next ten years.

AIR MEETINGS & EVENTS

(Continued from page 43)

pilots and plane owners. Sponsored by the Mount Plymouth Golf Club and Hotel. Mount Plymouth, Fla.

Engineering Display. Hotel Statler, New York

May

28—(through June 4)—Federation Aeronautique Internationale Conference. Stockholm, Sweden

June

4-9—Society of Automotive Engineers Summer Meeting. French Lick Springs Hotel, French Lick, Indiana
10-13—National Aeronautic Assn. Convention. Hotel Statler, St. Louis, Mo.
26-30—American Society for Testing Materials. Ninth Exhibit of Testing Apparatus and Related Equipment. Chalfonte-Haddon Hall, Atlantic City, N. J.

AVIGATION RESEARCH

(Continued from page 28)

common military-civil system. Evaluation of navigation aids will be conducted by the USAF's All Weather Flying Division at Dayton, Ohio, while CAA's Indianapolis Center will evaluate traffic-control aids.

While assigning actual development work to member Government agencies, the Board has let three study contracts directly. One calls for a group at Cornell Aeronautical Laboratory to investigate the probable characteristics of aircraft which might fly the common system 10 to 15 years from now.

Another group at the same institution is studying how Airport Time Utilization equipment at a number of airports can be integrated into a network, and Mr. Damon said gratifying progress was being made on this project.

The third study contract is with the Franklin Institute of Philadelphia, which is investigating the desirability and practicability of building a complete air traffic-control system simulator, and of building small simulators for study of individual air traffic-control problems.

The projects being carried on by the ANDB, Damon explained, were chosen through a careful screening process designed to assure economy of

January

9-13—Society of Automotive Engineers Annual Meeting and Engineering Display. Hotel Book-Cadillac, Detroit, Mich.
13-15—18th Annual All-American Air Maneuvers, Miami, Florida.
16-19—Plant Maintenance Show. Public Auditorium, Cleveland, Ohio.
17-19—Second Annual Custom Spray Operators' School. University of Illinois, Urbana, Ill.
23—Institute of the Aeronautical Sciences Honors Night Dinner. Hotel Astor, New York
23-26—IAS 18th Annual Meeting. Technical Sessions. Hotel Astor, New York
23-27—Southwest Air Conditioning Exposition. Hall of Agriculture and Poultry Bldg., Fair Park, Dallas, Texas
23-27—American Society of Heating and Ventilating Engineers. 56th Annual Meeting. Dallas, Texas
23-27—Private Seminar on Company Standardization Work and Formulation of Standard Specifications by Dr. John Gaillard. American Standards Assn. Room 501-A, Engineering Societies Bldg., New York
30—(through Feb. 3)—American Institute Electrical Engineers Winter General Meeting, New York

February

18-26—New York Airplane Show (part of Annual National Sportsmen's Show). Grand Central Palace, New York
27—(through March 3)—American Society for Testing Materials Committee Week and Spring Meeting. Hotel William Penn, Pittsburgh, Pa.

March

6-9—American Road Builders Assn. Annual Meeting (including Airport Division). Netherlands Plaza Hotel, Cincinnati, Ohio
28-31—Fourth National Plastics Exposition. Sponsored by the Society of the Plastics Industry. Navy Pier, Chicago, Ill.

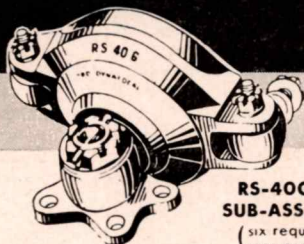
April

4-6—Air Transport Assn. Annual Engineering and Maintenance Conference. Hotel Continental, Kansas City, Mo.
10-14—American Society of Tool Engineers Exposition. Convention Hall, Philadelphia
16-20—22nd Annual Business Meeting of the American Assn. of Airport Executives. Neil House Hotel, Columbus, Ohio
17-19—Society of Automotive Engineers Aeronautical Meeting and Aircraft



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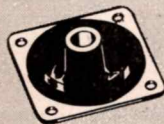
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Vibration Control Systems

effort in developing a common military-civil system. First, the Research and Development Board of the Department of Defense went through all military navigation projects, and declared some 60 to be "common system," as distinguished from those of a tactical military nature. Next, the ANDB studied which of these projects should be continued, and which should be discontinued or modified. Finally, the remaining projects were allocated among the participating agencies for development.

In connection with work on radar, an important part of the ANDB program will be development of a composite display in which all the necessary traffic-control information can be seen at one time by the controllers.

The ANDB also is sponsoring further development on many existing projects, such as ILS and GCA, which, it declared, show promise of making possible routine landings with 100-ft ceilings and one-quarter mile visibility.

The Air Navigation Development Board, in addition to Chairman Damon, is composed of Col. W. B. Lawew, Army; Capt. W. P. Cogswell, Navy; Col. S. A. Mundell, Air Force; and J. E. Sommers, CAA. B. A. Denicke is its Executive Secretary and Dr. Douglas Ewing is Director of Development.

LANDING SKID

(Continued from page 43)

above factors into consideration.

Ed Schoch, McDonnell test pilot, drew the assignment of "barrel jockey" on the XF-85. Before and between the several successful hook-ons, various combinations of circumstances made skid landings necessary. The first of these came about on the first flight. This particular flight was about as wild a ride as any test pilot has ever survived. Cast off into space in an airplane which nobody had even taxied, much less flown, Schoch had to learn, in a very few minutes, to fly it well enough to hang it up on a trapeze beneath the B-29 test parent.

The airplane did not trim out on this first free flight, wind tunnel results to the contrary, and constant back pressure on the stick was necessary. Between having both hands on the stick and consequent difficulty with throttle adjustments, as well as turbulence around the trapeze, Schoch, on his last pass, slammed the canopy into the trapeze, breaking out the glass and knocking off his helmet (with oxygen supply). Recovering several thousand feet below, Schoch felt the airplane out for a landing, and brought it in neatly on the Muroc sands. Everything considered, Schoch's feat in coming back with an airplane after running this gamut of unprecedented circumstances is one of the outstanding achievements of test flying.

This skid landing was made in August

time for decision!



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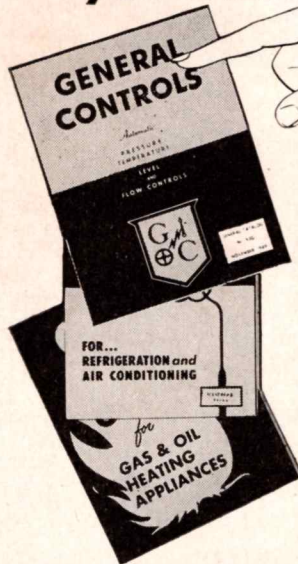
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So, please, buy and use Christmas Seals — send in your contribution, today.

Buy Christmas Seals

Because of the importance of the above message, this space has been contributed by

AERO DIGEST

1948. Schoch made three more, in October 1948 and March and April 1949. In all cases, the runout was nearly straight, with some damage to the forward fuselage where the skid crushed up against it.

The point of major interest, as far as determination of design data for prediction of skid landing behavior is concerned, lies in the friction coefficients determined from three of these skid landings. The *average* coefficients of friction computed from the landing data vary between .56 and .91. Lacking a "time versus runout" history, it is impossible to determine the variation of friction coefficient with speed. This coefficient might undergo some variation with dampness of the lake bed, and with the particular shape of the skid.

How Obtained

These friction coefficients were derived from the landing data by assuming that the airplane exerted *lg* on the ground throughout a length of run determined by measuring skid marks. Therefore the computation neglects the effects of the more than *lg* ground reaction due to the vertical velocity component in the first part of the run, and also neglects the effects of less than *lg* ground reaction due to wing lift. Under these assumptions, it is probable that the friction coefficient derived for the slowest landing, $\mu = .91$, is most representative of the true friction coefficient. The skid marks of the last landing show the airplane was skipping during the first part of the landing.

The skid marks also show that some of the directional stability (probably most of it) came from the restoring yaw forces of

wingtips dragging alternately, and the rudder-like behavior of the ventral fin.

The conclusion drawn from the design development and the flight test results is that

skid-landing characteristics, while not susceptible to exact analysis, can be evaluated in a sufficiently quantitative degree so that successful landings will result.

STRATEGIC BOMBING

(Continued from page 64)

their height, their speeds and what protection night and the elements may afford? Or do they require escort fighters of long-range, either single or multi-engined aircraft? Can they go part of the way escorted, the balance of the distance unescorted, and yet survive the return journey? If a long-range multi-engined fighter, carrying only armament, is used in escort duties, can it fight off one or two dozen nimble little interceptors? Or is it only another huge target, like the bomber it is seeking to defend? Will the losses of bombers, escorted or unescorted, be acceptable or prohibitive? Will the losses be so great that the entire bombing offensive must be dismissed as a hit-and-run affair, only possible in the worst weather, and at night?

The answer for Russia may be to build a strategic bombing force that will be smaller and less effective than the combined American and British forces, or even less powerful than the American force alone. It must be powerful enough at least to assure that the British and American will employ large defensive forces to protect their homelands, thus diverting much airpower to purely defensive tasks. The main

Russian emphasis may well be on air defense, for which their geographical position gives them a decided advantage. Their country is huge; the distances to many of their industrial areas are great.

The Russians may accept deliberately an inferior position in the field of strategic bombing, and rely upon a preponderance of strength in jet interceptors, chief weapon of the air defensive—which also includes radar-warning nets, anti-aircraft and searchlight batteries. The Russian position therefore may be: "hold in the air, attack on the ground."

On the ground in Europe, the Russians quite obviously have the initial advantage, which they may choose to exploit. General Omar Bradley declares that they could put 165 divisions into the field within three months, 500 divisions within a few more months.

To oppose the westward march of this tremendous army, accompanied and protected by an excellent tactical air force, we have the armies of the western European democracies—which collapsed, along with the British Expeditionary Force, against Hitler's army—and such divisions and sup-



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Congress has passed the 15,000,000,000-dollar National Defense Appropriation Bill. Billions of this money will be spent by the Air Force, the Army and the Navy for many kinds of aircraft and for everything—from engines to screws and nuts and bolts—that go into the finished product. These expenditures will make the aeronautical market the biggest market in the world. That means unlimited sales opportunities for every aeronautical product if the manufacturer gets his sales message to the right people.

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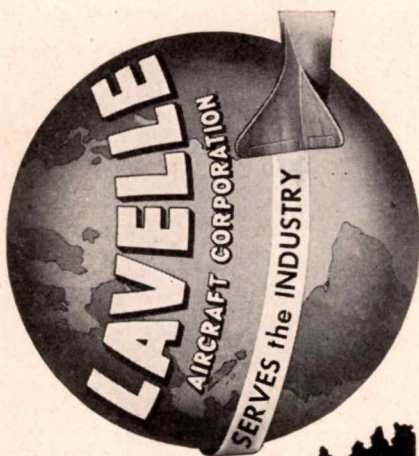
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porting air forces as we and Britain can send to Europe when we learn the Russians are moving.

It appears obvious that the initiative lies with the Russians. We are not bound to a policy of aggression, but pledged to a policy of defense only. It is doubtful that we would move first, even to the extent of greatly strengthening our meager occupation forces in Germany. As usual, it seems that we must be the last to move. If the Russians believe that they are slightly behind the eight ball in strategic bombing, it is certain that we are squarely behind the eight ball in a war of movement on the ground.

I offer no apologies for being able to see no further and no more accurately than the World War II General Staffs of two great nations. I state merely that it is my considered guess that the Russians may overrun France, Belgium and the Netherlands unless we stop crouching behind our mental defensive wall of strategic bombing—the American mobile equivalent of the French Maginot Line—and see what, if anything, we can do to pin down that Red Army, if not in Germany, at least in the Eastern part of France and away from the Channel Coasts of France and Belgium.

If the Russians make as easy and as great gains of territory in their westward march as the Germans accomplished in World War II, they will have won rocket-launching sites on the French and Belgian coasts from which they may dispatch V-2 rockets against every city in England, at least as far as the Midlands. And the war-head now may be filled with an atomic explosive, rather than old-fashioned TNT.

What defense can the British erect against those rockets? So far as I know, the only certain defense against rocket attacks is to deny the enemy the use of launching sites within the rockets' range. And such denial will not be accomplished by the strategic air bombardment of Minsk, Pinsk, or even Borsht. It seems to me that if the Russians move westward, with their possibly old-fashioned army of tremendous power, we will look slightly ridiculous flying 40,000 ft above their heads to bombard the civilians of Moscow and Stalingrad.

But, you may say—as some strategic bombing enthusiasts have said—"We'll have to let the Russians overrun Europe, because we haven't the ground strength to oppose them. We must depend upon our Strategic Air Force to blast Russian industry to atoms. Then, without the means for supplying their armies, the Russians will have to retreat. By that time we will have built up a powerful American Army and can stage another invasion of Europe. 'We did it before, and we can do it again.' With our powerful strategic and tactical air forces we'll drive back those millions of Russians."

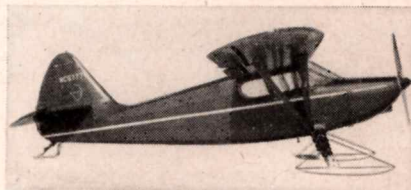
If Great Britain is forced to sue for peace, we'll lose our embarkation point for a cross-Channel invasion—and direct invasion from the U. S. is not apt to prove another African invasion against the French, with the Germans far along the African coast. The Russians will be right there in Europe to greet us.

Furthermore, there are some 350 million inhabitants in Europe, and if all of them are swept behind the Iron Curtain, the industries of these nations will be set to

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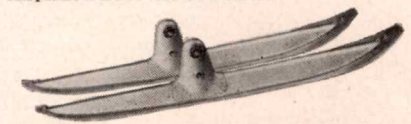
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work for the Russians. In that event, after we have blown up all Russian industry with our atom bomb, we'll have to blow up much of Russian-dominated European industry as well. And if we actually effect that, then all of Russia and Europe will be one vast poorhouse—with no roof.

Since time immemorial, the legitimate objective of every armed force throughout history has been the defeat of the armed forces of the enemy. The armed forces of Germany and of Japan were soundly beaten, in the field of combat—on land, on sea, under the surface of the sea and in the air.

The Jap Air Force and Navy were beaten *before* our B-29's dropped their first bombs on Japan. The destruction of Japanese industry—including the atomic experiments on Hiroshima and Nagasaki—was an anticlimax. The atomic bomb served chiefly as a face-saving gesture for the Japs; their goose was cooked anyhow, and they knew it.

And the Royal Navy and the U. S. Navy helped by getting everything necessary across to the various scenes of conflict, sinking the German submarine force in the process, until by war's end there were only scattered survivors.

It is indeed odd that officers of our Army, Navy and Air Force should find themselves, at this late date, squabbling about a detail of warfare—an important detail, but still only a detail of airpower itself. And the tasks of armies, navies and air forces are only parts of the vast human effort that goes into modern war.

The Soviet Bloc

Look at the world on Mercator's projection. Russia is the largest land mass. With communist China and the satellite communist-governed nations of eastern Europe, it comprises the world's largest land area whose collective population is dedicated to one political ideology, the spread of communism over the entire globe. Russia is bounded on the east by the Pacific Ocean; on the south by Nationalist China, Burma, India, Turkey, Greece; on the west by the still democratic states of Europe and by a small segment of the far-north Atlantic Ocean. Russia is essentially a land- and sea-locked nation.

It is indeed behind an Iron Curtain—a curtain of oceans over which it has not the power to sail, of nations whose political ideals are inimical to its own. Consolidated in its relation to the rest of the globe, it is an island.

Russia has no surface sea power worth mentioning; it cannot dispatch its comparatively few merchant ships to any part of the globe unless it is permitted to do so by the world's two great naval powers, Great Britain and the U. S. The British and the Americans have sea access to the entire globe—including the coasts of Russia.

The air is everywhere, and any may travel through it, even over the territory of enemy nations if they have the force necessary to fight their way. Today, the commercial airlines of the U. S., Britain, Holland, Sweden and other democratic nations are flying tens of thousands of air miles on regular uninterrupted schedules. Protected by powerful air forces, as merchant shipping is protected by navies, this commercial air network circles the globe, ready instantly

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to be used for military transport—the moment that war comes. Ready also is the Military Air Transport Command of the U. S. Thus, on the sea and in the air the U. S. and the British Empire have the means to converge, in the shortest possible time, on any place on the globe where enemy military forces may start operating.

There is only one pivotal point from which the Soviet Union may conceivably exert sufficient war pressure to neutralize a large part of this air and sea force by which it is surrounded. That point is in northern France and Belgium—major battleground in two world wars, in the Franco-Prussian war and in the Napoleonic war. If the Red Army can capture that pivotal point and employ guided missiles, it may knock England out of the conflict. That is a reasonable supposition. If it occurs, the industrial strength of the British Isles may be forced to work for the Russians.

But this much is certain: Irrespective of what air power and what under-surface sea power the Russians may possess, their great strength lies in their present position in Asia and Europe and in their mechanized ground Army with its supporting tactical air services. If we and our Allies can defeat that Red Army before it achieves its initial objective—the capture of Belgium and northern France—we will have knocked out the only major war-proved weapon upon which the Russians can place any reliance. How to knock it out should not prove an insoluble problem to the Joint General Staff of the U. S. and the British Empire. They have in their hands today the power to overwhelm, defeat, and obliterate the greatest and most powerful army the world has seen.

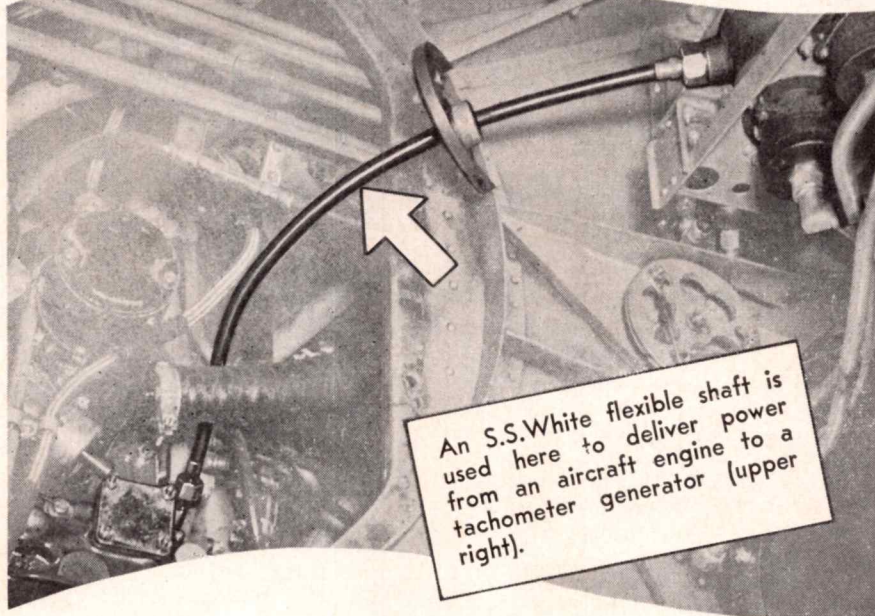
Our defensive strategy for western Europe should include these factors: plans for the immediate convergence of all tactical air forces, under British and American command, upon operational fields in England, France, and Belgium; the employment of U. S. Navy fighters and bombers, operating either from their carriers or from land bases supplied by the Allied air forces for their use; the immediate mobilization and putting into war service of all commercial airline equipment, British, American and others, needed to transport overseas an army and much of its equipment to the battlefield; the use of the Navy's now outmoded battleships as fast tankers.

Of course, no such plan will be possible if the U. S. Navy insists that it has only a seagoing air force whose planes cannot be pried loose from their carriers. And it won't work if the Navy insists that its battleships must not be relegated to the humble task of transports and tankers, but must plow the seas with bristling guns, looking for Russian schnorkel submarines. Neither will such a plan work if the Joint Chiefs of Staff can't decide which Service holds paramount interest in the business immediately at hand.

The entire force—air, ground, sea—in such an operation should be under the command of one man.

Under the terms of the Atlantic pact, we are arming the nations of western Europe. From the Russian viewpoint we are turning that old battlefield of Europe into an armed camp. In a year or two—perhaps three or four—we may make Europe a very

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hard nut for the Russians to crack. If the Russians are to win a quick war, they may decide to start with the first good weather of late spring or early summer—say around Memorial Day, 1950. That would give them the five months during which Europe's weather is the best.

The Russians appear to be losing the political battles of the cold war. There is dissension and unrest in the communist satellite nations. With American prestige gaining ground, and with American money becoming an ever more-important factor in world politics, the Russians may decide that a shooting war offers a better chance of victory.

Their objective in such a war may be a limited one—not the actual defeat of the U.S., but its isolation from Europe, the splitting of the British-American combine, the inclusion of England within the Soviet orbit. If they achieve that objective, we may find it expedient to make peace. Or we may elect to carry on strategic-bombing warfare. And that is a type of hostilities in which we have had no experience on the receiving end.

AIR COMPRESSIBILITY

(Continued from page 37)

done all in one step, as follows

$$V_1 = V_2 \times \frac{T_1}{T_2} \times \frac{P_2}{V_2} \times \frac{Z_1}{Z_2}$$

$$= (V_1 + 30) \times \frac{530}{395} \times \frac{515}{1815}$$

$$\times \frac{.9966}{.948}$$

$$= (V_1 + 30) \times .4$$

$$V_1 = 20 \text{ cu in}$$

Note: Z_1 is had from Table I.

For the sake of completeness, I should mention that recently I have recommended a 20% factor of safety over the force required by the piston mechanism and, in addition, as a rough approximation, I have usually

added another 15% to represent the additional volume required to allow for adiabatic expansion as against isothermal. Obviously, as the art becomes more refined, we shall have to

go further into this point, but it hardly seems necessary at this time, and I have not employed either of these factors in the sample computations herein.

TABLE III

Values of Z for Air—Constant (Density)

Temp.	1815 at 70° Pres.	Z	Temp.	2015 at 70° Pres.	Z
150	2160	1.0337	150	2400	1.0411
140	2116	1.0298	140	2356	1.0371
130	2076	1.0255	130	2304	1.0330
120	2034	1.0209	120	2254	1.0279
110	1989	1.0161	110	2204	1.0227
100	1946	1.0116	100	2152	1.0176
90	1903	1.0069	90	2111	1.0124
80	1862	1.0018	80	2070	1.0071
70	1815	.9966	70	2015	1.0011
60	1776	.9906	60	1963	.9948
50	1730	.9848	50	1917	.9882
40	1680	.9786	40	1858	.9810
30	1634	.9720	30	1816	.9743
20	1598	.9652	20	1765	.9665
10	1548	.9584	10	1716	.9588
0	1502	.9504	0	1664	.9502
-10	1458	.9426	-10	1614	.9414
-20	1416	.9343	-20	1554	.9325
-30	1370	.9267	-30	1513	.9231
-40	1322	.9163	-40	1457	.9125
-50	1276	.9069	-50	1411	.9023
-60	1233	.8971	-60	1351	.8909
-65	1212	.8917	-65	1328	.8855

CROP-DUSTING REGULATIONS

(Continued from page 21)

wish to engage in the business of operating agricultural aircraft, with particular emphasis on financial responsibility, airworthiness of planes and licensing of agricultural pilots.

Pilot qualifications are outlined in the third section, which states that all agricultural pilots must possess a valid CAA Commercial certificate together with a second-class physical certificate. Further, both the pilots and their aircraft must be authorized by the CAA to engage in aerial agricultural application.

The California State Department of Agriculture shall issue an Aerial Agricultural Applicator's license to any pilot who submits proof that he possesses certain minimum qualifications. There are two types of licenses, Unrestricted and Apprentice, for two different categories of aircraft, Fixed-

wing and Rotary-wing.

An applicant for an Unrestricted Fixed-wing pilot's license, must be 21 years of age, a resident of the State for at least one year; and have 1000 hrs pilot time, of which 100 hrs must be as an Apprentice Applicator. Pilots currently engaged in agricultural applying may substitute 200 hrs dusting or spraying pilot time within the State, in lieu of the possession of an Apprentice license. Unrestricted Rotary-wing pilots must have a minimum of 50 hrs pilot time in rotary-wing aircraft, of which 10 hrs must have been spent as an applicator within the State.

Apprentice Fixed-wing pilots must have a minimum of 350 hrs pilot time, of which 50 hrs must be in the class and type aircraft to be used in agricultural operations. Apprentice Rotary-wing licenses will be issued

to any individual who certifies that he will conduct only agricultural flights under the personal direction and supervision of an Unrestricted pilot.

All pilots must demonstrate that they are thoroughly familiar with the progress and development of aerial applications of all agricultural "dusts" and sprays and may be called upon to demonstrate their application ability by actual flights. Apprentice Rotary-wing pilots are exempt from this flight test, however.

Section IV deals with conditions of maintenance and equipment of aircraft used in agricultural application. They should comply with all rules and regulations of California Aeronautics Commission, as well as those of the CAA. In addition, all aircraft must be equipped with a positive method of shut-off between the hopper and the nozzle to prevent leakage of material when not actually spraying or dusting.

The last section concerns causes for and method of suspending or revoking Aerial Agricultural Operators' Licenses. After an impartial hearing, licenses of the operator and or the applicator can be suspended or revoked for cause by the Director of Agriculture. Three suspensions shall result in automatic revocation of any license.

Mere Recommendations

It should be understood that these regulations, at the moment, are only the suggestions and recommendations of a cross-section of industry. They may or may not be adopted or modified by the Dept. of Agriculture of the State of California in any manner deemed advisable by that agency. The California Aeronautics and the Coordinating Committee of Agricultural Usage of Aircraft Commission will welcome the comment of agricultural pilots in other States with regard to these suggested regulations. Copies may be obtained by addressing the Commission at Sacramento, California.

As a fitting climax to this discussion, we have just received a report from the U. S. Department of Agriculture giving the statistical results of a two-week aerial war on grasshoppers, during the plague last summer in Wyoming and Montana. At the height of the infestation, the grasshopper population reached as high as 2000 per square yard. Three Government planes and 37 private aircraft declared an aerial war on the insects and in two weeks, killed an estimated 522 billion grasshoppers over a 2½ million-acre area. To emphasize the amazing extent of this accomplishment, Federal statisticians figured that the dead insects weighed 175,000 tons and would have made a pile filling the average city block to a height of more than 400 ft.

As a result of these and other notable advances in agricultural aviation, the CAA, the Department of Agriculture, the National Flying Farmers' Association and the Personal Aircraft Council of AIA have banded together to develop a new type of aircraft, solely for agricultural purposes. Plans call for the assignment of the development program to the Personal Aircraft Research Center of Texas A&M College, since it has what the CAA calls "a suitable aeronautical and agricultural plant, well adapted for the purpose."

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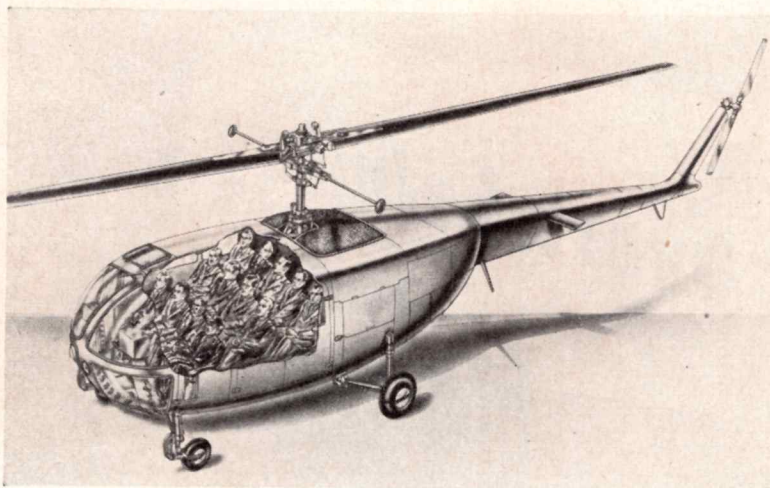
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GEAR PRODUCTS



Engineering sketch of Bell Aircraft "Feeder-Liner"

'COPTER SERVICE FOR NEW YORK

(Continued from page 54)

will use roofs; (3) it should be possible to operate a helicopter service to the airport, at a profit, and at a taxicab rate of 25 cents per mile per passenger.

For a long time, people have been saying that the helicopter never would be useful in air transport until it could carry at least ten passengers. David G. Forman, manager of the Helicopter Division of Bell Aircraft, agreed with this view and his company, acting accordingly, announced its new *Feeder-Liner*, a helicopter capable of carrying a pilot and up to 12 passengers. Prototypes of the *Feeder-Liner*, intended for passenger and air-mail service in metropolitan areas, have been flying successfully for three years. The *Feeder-Liner* can be equipped with conventional helicopter wheels or with amphibious landing gear, as the terrain demands. The new model retains the single, two-bladed main-rotor and other features of the smaller two and three-place Bell helicopters.

Frank Piasecki, young president of Piasecki Helicopter Corp., favored the larger helicopter just as strongly. He pointed out that his company had been building helicopters able to carry 10 passengers each since 1945. The helicopter, said Piasecki, was capable of going into the business of passenger-carrying now. It would soon have multiple powerplants for added safety. Fire protection was easy because the powerplant was enclosed. He left with the assembled experts a striking sketch of a large passenger-carrying helicopter, the Model PD-17C, the commercial version of the Navy HRP-2.

The conference closed with a talk, as graceful and illuminating as ever, by Igor Sikorsky. All the leading

helicopter manufacturers are thinking of large machines, and Sikorsky made the announcement that his company would, in about two weeks, test the S-55. Ordered by the Army, it is a single-engined, single-rotor helicopter, large enough to carry ten passengers and a crew of two.

cargo. The cargo-passenger relationship can be adjusted quickly from 92 passengers with 4400 lbs of luggage and cargo to all-cargo or to any combination of passengers and cargo. The airplane, therefore, is adaptable to seasonal variations in traffic, as well as to directional traffic in which the predominant passenger load is in one direction and the predominant cargo movement is in the other.

Another natural development of the DC-

Van Dusen Heads ADMA

AT THE seventh annual meeting of the Aviation Distributors and Manufacturers Association, French Lick, Ind., Nov. 9-11, G. B. Van Dusen, Van Dusen Aircraft Supplies, Inc., was elected president. Chosen vice-presidents were: R. W. Richardson, Goodyear Tire and Rubber Co., and George W. Jalonick III, Southwest Airmotive Co.

John D. Harris, Pacific Airmotive Corp., was elected to the board of directors, term expiring in 1951. Also made directors, but with terms ending in 1952, were: Frederick H. Lee, Jr., R. M. Hollingshead Corp.; Arthur C. Harvey, Air-Parts, Inc.; A. E. R. Peterka, the Lamson & Sessions Co.; and T. H. Davis, Piedmont Aviation, Inc.

American Welding Society

The American Welding Society has elected O. B. J. Fraser president for the year 1949-50. He took office at the Society's annual meeting in Cleveland in October.

Harry W. Pierce, Charles H. Jennings, L. C. Stiles, John A. Grodrian, and W. F. Boyle were elected vice-presidents. A. F. Davis was named a director.

The 1949 Adams Lecture was delivered by W. M. Wilson, research professor of structural engineering, University of Illinois. A. G. Bissell received the 1948 Samuel Wylie Miller Memorial Medal and A. Amirikian the Lincoln Gold Medal of the Society.

EVOLUTION FOR CARGO

(Continued from page 50)

6A is the DC-6B luxury passenger transport. In this arrangement, the same luxury interior is provided as in the DC-6, but with additional seating space. The domestic day-plane version of the DC-6B carries 64 passengers, while the corresponding DC6 version of the airplane carries 56 passengers. The transoceanic DC-6B, with its larger galleys, coatrooms and toilet compartments, will be able to carry 54 passengers in comparison with the present DC-6 limit of 48.

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Type: Cargo, passenger or passenger-cargo.

Performance: max. speed—355 mph; cruising—312 mph; service ceiling at 100,000 lbs—23,900 ft; landing distance at 85,000 lbs—5020 ft; absolute range with 3322 gals fuel—2970 mi; absolute range with 4700 gals fuel—4475 mi.

Specifications: wingspan—117½ ft; length—105½ ft; height—138 in max.; empty weight—49,767 lbs; max. take-off weight—100,000 lbs; maximum landing weight—85,000 lbs; max. fuel capacity—4700 gals. Electrical system—300-amp, 28-volt DC. Fuselage—semi-monocoque, 75S aluminum alloy in three jointed sections bolted together at butt joints; wing center section permanently jointed to fuselage. Wings—full-cantilever, all-metal of 75S alloy. Tail—full-cantilever, all-metal except rudder, which is fabric covered; elevators & stabilizers interchangeable. Hydraulic system—3000-psi working pressure from two engine-driven pumps in

inboard nacelles. Air-conditioning—300,000 BTU internal-combustion heater; aftercooler and expansion turbine, all automatically and thermostatically controlled. De-icing system—300,000 BTU internal-combustion heater in each outboard nacelle and one in after fuselage; propellers & air scoops are electrically de-iced; windshields are de-iced by cabin-heater air with standby alcohol equipment. Pressurization—two engine-driven, variable-speed Douglas cabin superchargers supplying 80 lbs of air per min at a pressure differential of 4.16 psi. Powerplant—4 P&W R-2800-CB-17 Double Wasps in package mounts rated at 2500 take-off hp with alcohol-water injection, 1900 max. continuous hp. Hamilton Standard or Curtiss high-activity, reversible, full-feathering 3-blade propellers. Pioneer PB-10 or Sperry A-12 electronic autopilot.



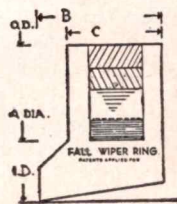
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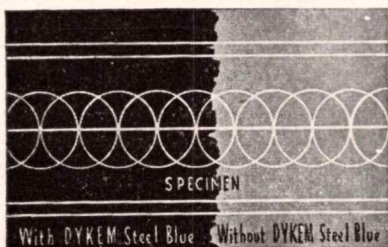
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'COPTER EXPLOITS

(Continued from page 54)

undersides of cattle. Here is where the helicopter comes in. Insecticide is fed from a tank into an especially designed exhaust tailpipe in Sikorsky S-51 helicopters. The swirling effect of the down draft from the rotors makes the "smoke" hit the ground and "curl up" under cattle as well as foliage. The helicopter is expected to police great areas and gradually eliminate the pest.

The curling effect of the insecticide from the helicopter is being tried in Zululand, and results have exceeded expectations. Bertram Ainsworth of United Aircraft Expert Corp., who recently returned from a trip to South Africa, reports that the helicopter flew at 20-30 mph 15-20 ft above the ground and was able to get into the ends of valleys and inaccessible crannies which the faster, fixed-wing aircraft could not touch.

• Now back again to the United States! Springville, New York, a town of 300 people, distressed by the sharp increase in polio cases, called upon a Bell Aircraft helicopter to wipe out the fly and mosquito populations. An airborne, DDT-laden aerosol fog,

forced into every nook and crevice by the powerful downdraft of the helicopter's main rotor, deluged swamps, stagnant pools and a river which meanders through the town. The fog brings death to insects but is harmless to humans.

• Now to Central America! To Dr. Matthew W. Stirling of the Smithsonian Institution in Washington, D. C., the helicopter is the answer to an ethnologist's prayer. It is a flying machine that can pop him down conveniently through the clouds to look for ancient fossils, mounds and traces of aboriginal civilization, can save him long hours now given to fruitless searches, and spare him the trials of being forced to eat and sleep with formidable native guides while beating off jaguars and ticks.

Since his first historic archaeological trip with two Sikorsky H-5 helicopters into the dense savannahs of Panama last May, Dr. Stirling has discovered ancient refuse mounds, some 1400 years old, around the upper Tigre River region, all the while sleeping at night in a comfortable bed at Albrook AFB at Balboa, Canal Zone! From the nose of an Air Force helicopter, Dr. Stirling was able to differentiate between aboriginal earthen mounds and natural hills, and to part

the dense jungle canopy by the downdraft from the rotor blades.

• The five exploits listed are something to be proud of. Whether the public will be proud of the next one or not depends on how law-conscious it happens to be. At any rate, the use of a helicopter recently resulted in the arrest of four men and the confiscation of a still, 2000 gals of alcohol and 40,000 gals of mash!

Taking a tip from war-time aerial mapping of enemy positions, Walter E. Brown, agent-in-charge of the Newark Alcohol Tax Unit of the U. S. Internal Revenue Bureau, secured the cooperation of the Coast Guard in flying over the suspected location of the still. While in the air, Brown photographed the area and noted possible points of entrance—and escape. Later, working from the pictures, he was able to deploy ten agents so that none of the still operators could escape into the woods.

Honor Marvin Miles

Marvin G. Miles, aviation editor of the Los Angeles Times, has been awarded the special Arts and Letters award of the California Wing of the Air Force Assn. It was given to Mr. Miles for his effective reporting on aviation development and the maintenance of American air power.

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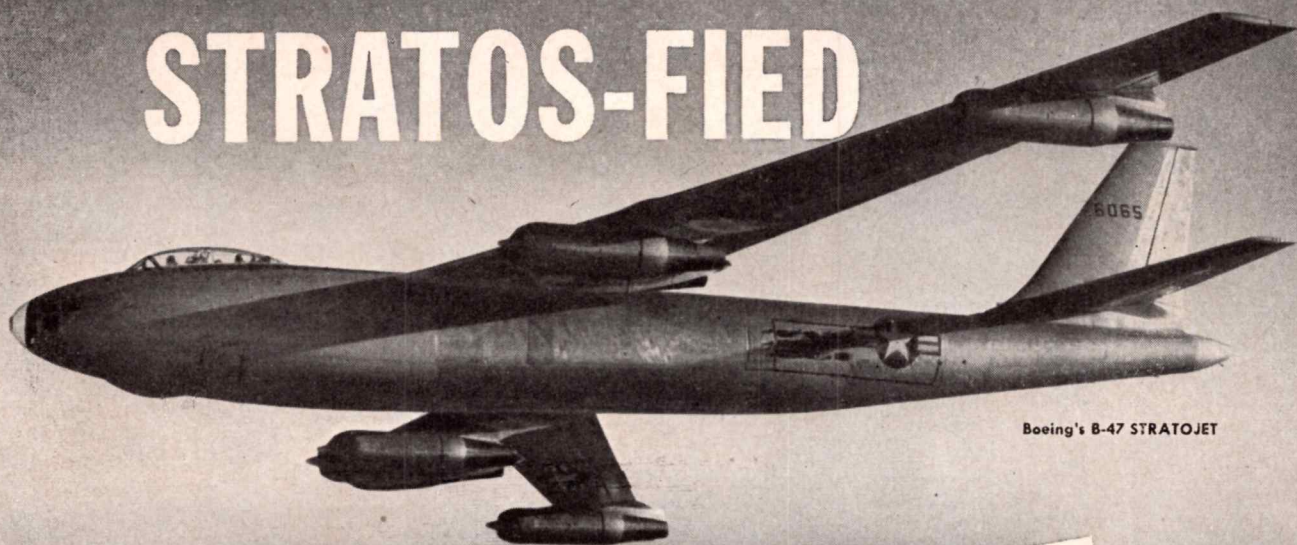
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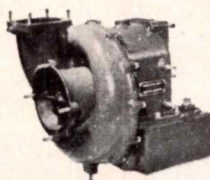
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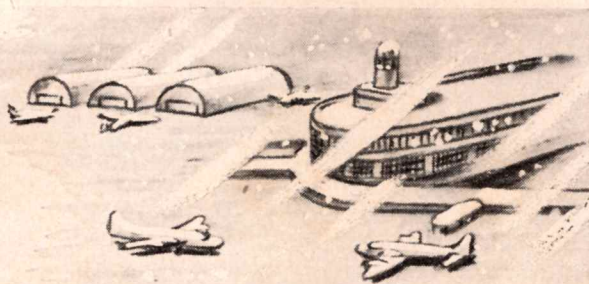
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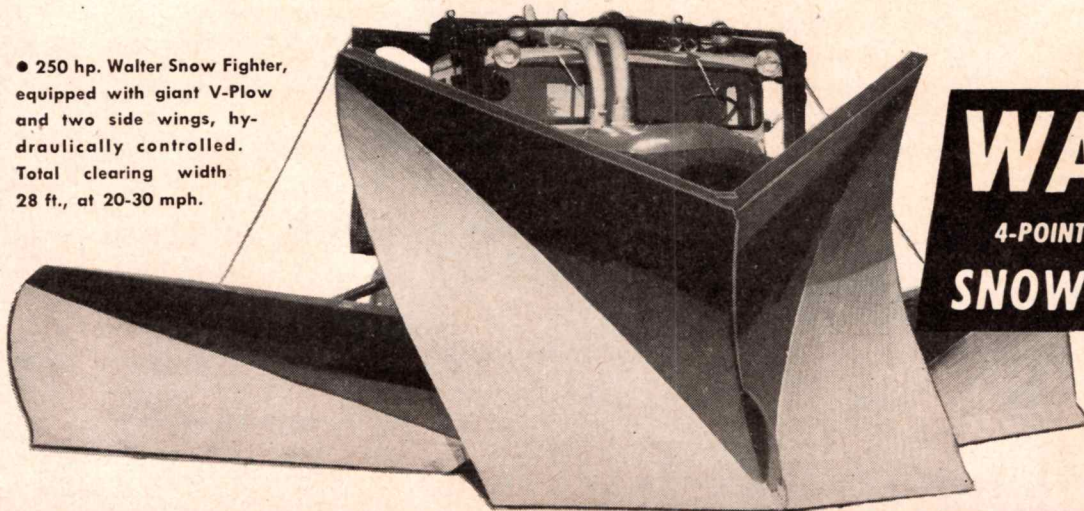
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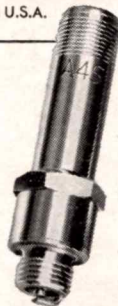
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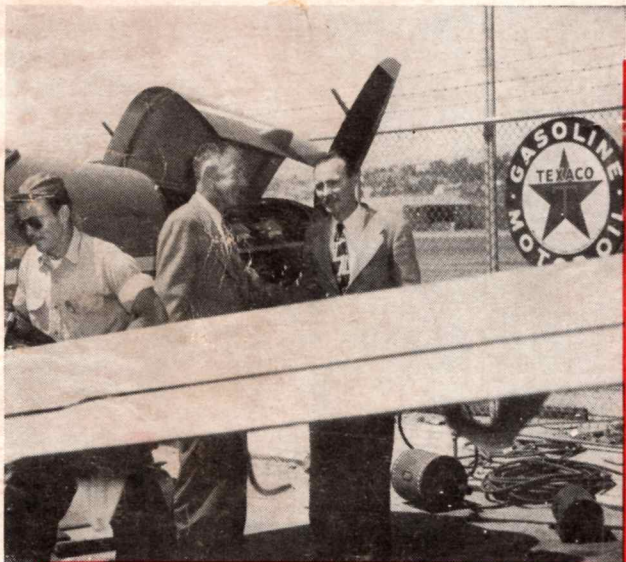


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